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THE NEW YEAR.

Whatever 1906 may have been for the electrical engineer and manufacturer, and some idea of its trend and results is given in these columns, there is no good reason to believe that 1907 will be any less productive and fruitful. It cannot be denied that in many ways 1906 was a wonderful year, witnessing unequalled expansion, so that to maintain such a rate of growth would be beyond human powers. But it is not healthy to be ever stimulated to the extreme of ability and capacity, and just as much solid progress can be made in periods of outward calm and comparative relaxation. Hence are welcome the general tone of caution, the conservatism in dealing with new projects, the desire to solidify fresh ground and that general attitude of discrimination which carries with it an assurance against both "boom" and "break." In reality, so far as the financial outlook goes, the fact that the prices of securities are themselves below the level of a year ago indicates the absence of dangerous speculation. The only thing that could be healthier would be a corresponding decline in the price of commodities; but so long as consumption exceeds production, no drop can happen; and hence the probability of comparative steadiness until the uncertainties of the presidential campaign invade the public consciousness.

In the electrical field every department is fortunately alive to the finger tips as to new ideas, inventions, processes, methods. Telephony holds its own with electric lighting, and both challenge the leadership of the trolley, while all three are rapidly shifting to bases of lower cost, higher economy and greater service to the country. As to the scientific and technical aspects of electricity, these are all hopeful, and some of them are discussed in the current issue, as to the record and outlook. In fact, our review of the year in the various branches is too complete to be presented entirely in one issue, and several of the editorial articles must necessarily await appearance later in the month.

THE INCANDESCENT LAMP REVOLUTION.

"It never rains but it pours" is an adage particularly applicable to the surprising situation with respect to new types of incandescent lamp filaments which has developed within a twelvemonth. Less than a year ago the tantalum filament with its consumption of 1.9 watts per candle was announced, the most startling advance in incandescent electric lighting invention since the pioneer work of Edison. Several months later came the news of the development of the tungsten filament with its consumption of 1.2 watts per candle, thus rendering the tantalum filament obsolescent before it had entered the commercial stage. The third chapter is furnished by a paper presented last week before the American Association for the Advancement of Science, describing an entirely new type of composite filament for which a consumption of 1 watt per candle is claimed. As will be noted in the abstract printed elsewhere of the A. A. A. S.

paper, the newcomer, called the "Helion" filament by its inventor, Prof. H. C. Parker, of Columbia University, is not of the metallic type, thus demonstrating the incorrectness of the recent assumption that the lamp of the future was bound up with the use of the earthy metals. Notwithstanding the composite character of the filament, it possesses the remarkable property of its metallic prototype in being insensitive to fluctuations of voltage far beyond the limit of the carbon filament—a property of the highest importance in central station work. Last week was rendered further notable in the incandescent lamp calendar from witnessing the issue of the first patent on the tungsten filament, the specification and claims of which are reprinted practically in full elsewhere. These latest stages of incandescent lamp development should serve to impress upon central station men the nearness of the commercial problems which the incandescent filament revolution will bring to them, and the necessity of giving earnest thought at once as to how they are satisfactorily to be met.

The Alcohol Engine.

Elsewhere we present a most interesting article by Prof. Elihu Thomson discussing the principles of and probable future of the gas engine. It is shown that, happily, while the thermal value of alcohol is below that of its ill-smelling and dangerously explosive oil rivals, the higher point of ignition of the former involves a higher compression with correspondingly higher thermodynamic efficiency, thus counterbalancing the heat deficiency. Among the intrinsic advantages of alcohol are, of course, its lack of disagreeable exhaust odor and non-explosiveness, together with a cooler exhaust and less liability to preignition. The alcohol engine is an ideal source of power for isolated electric plants, and its commercial development is, therefore, of interest to the electrical public. Unfortunately, the price of alcohol in the near future, which the Department of Agriculture estimates at 35 cents per gallon as against oil products normally less than half that price, will materially affect the commercial adoption of the alcohol engine. Prof. Thomson points out, however, that some of its advantages may be secured through the use of a mixture of alcohol and gasoline, the proportion of the latter decreasing with decrease in price of alcohol.

Engineering Education.

We commend to our readers the remarkable article printed elsewhere on "Engineering Education." The writer, Mr. B. A. Behrend, is not only exceptionally qualified by education, by knowledge of both European and American instructional methods and by engineering experience, to discuss the subject authoritatively, but moreover possesses in a high degree the gift of literary expression. While agreeing in the main with the views of Mr. Behrend, we feel that one very important aspect of the subject has not received consideration, and that is the art of the teacher—the art of exposition on which the writer himself has such a strong grasp. Assuming that an engineer is a great leader in his profession, that his achievements should be a source of inspiration to students, he may nevertheless be lacking in all of the qualities of a teacher. As we review the line of great teachers from Socrates to Huxley, from Alcuin to Kelvin, we must perforce acknowledge that the art of training the immature mind is one requiring for its highest performance specific qualities no less rare and no less important than those widely different ones which lead to eminence in the practice of engineering. Merely to impart bare information is but one of the functions of the teacher; he should also, consciously or unconsciously, be a physcologist adept in the processes of the mind, and possessed of a sympathetic knowledge of adolescent human nature. His function is that of developing the mind, of training its powers no less than storing it with formulas and facts. Moreover, the school period of the engineer should be one pre-eminently for the acquisition of fundamental principles, for the laying of the foundation upon which the after engineering career shall be erected. An engineer has been defined as a man "with some technical knowledge and trained judgment." As between a good teacher and a good engineer, the former is more competent to impart the fundamental technical knowledge, and jurgment can only be trained in actual hourly contact with practical work involving the commercial factor in work where a failure of judgment may mean the temporary loss of a livelihood. There are some instances where the engineer embodies also the teacher—we need only mention Thurston and Burr, Behrend and Steinmetz—but it is a rare combination. In so far as the engineer supplements the work of the trained and professional teacher, we agree with Mr. Behrend as to his educational value.

Still another point not touched upon in the article is the value of engineering education aside from the direct practice of engineering. Only a small percentage of technical graduates find their way to professional careers, the majority in time becoming fixed in administrative and commercial positions. In fact, the mental training alone, aside from its technical character, makes of the technical graduate splendid raw material for any walk in the industry to which his education has attached him. Prof. Shepardson in an article elsewhere points out the great value to central stations of the technical graduate, and while heartily agreeing as to the profit that inures from his technical services in this connection, we believe that as raw material he is also better equipped for the administrative and commercial departments than the young man taken from the ordinary walks of life.

Electrical Growth in 1906.

In accordance with its usual custom, the Electrical World presents herewith some data and estimates bearing upon the industrial and commercial development in electricity during the past year. It must be admitted that 1906 is a difficult year upon which to make calculations, so far as the earnings of public service corporations are concerned, for the reason that the basic year 1902 is now rather remote, the figures for that year being the last compiled by the United States Census Bureau. On the other hand, the figures as to manufacturing are much more authentic, as the government statistics for 1904 have become available. The past year has, however, been one of such extraordinary growth and expansion, no one can claim to be able to average very closely the product of 800 manufacturing concerns and the earnings of some 12,000 to 15,000 public utility companies. Still, with well-determined bases, a result may be presented which cannot be very far out of the way. If anything the subjoined figures would appear to be unduly conservative, but that is a safe way to get at them.

As to electrical manufacturing it may be noted that the authentic government figures for 1904 show a total of $159,551,402. Our own estimate was $175,500,000, but as the government figures are taken at a "factory valuation," it will be seen that our guess was in reality an extraordinarily close one. Assuming a general 20 per cent increase for 1905, that year was estimated by us to have a product worth $217,400,000, which may have been high, but was probably near the realties. But revising the figures, taking the actual items of 1904 as a basis and assuming for 1905 a gain of only 10 per cent, and for 1906 a gain of 20 per cent, the following result is reached:

ELECTRICAL PRODUCTION, 1906.

Dynamos	$16,928,500
Motors	27,529,200
Transformers	5,898,500
Switchboards	4,971,200
Batteries	5,601,900
Carbons	3,578,400
Arc lamps	2,078,200
Incandescent lamps	9,178,200
Electric lighting fixtures	7,000,000
Telephone apparatus	21,000,000
Telegraph apparatus	1,466,700
Insulated wires and cables	45,566,000
Electric conduits	3,189,400
Fuses and lightning arresters	1,920,800
Resistances, heating and cooking	1,753,900
Electrical instruments	6,606,300
Circuit fittings	4,653,600
All other products	36,000,000
	$204,920,800

This certainly is bedrock and doubtless far below the mark. For example, the General Electric, Westinghouse and Western Electric Companies, according to their published reports, had a joint output in 1906 somewhere in the vicinity of $150,000,000, more or less, leaving a very small balance to be made up by nearly 800 other concerns, some of them producing millions of dollars' worth annually. It is reasonable to estimate, therefore, that the pubic paid about $250,000,000 for its electrical apparatus in 1906.

The next element of calculation relates to the earnings of the public utility corporations. Here the fluctuations and variations are very wide. Many even of the largest of these, outside of telegraphy, showed a gain of from 20 to 30 per cent in their gross earnings. Our total estimate for 1905 was about $720,000,000. The figures are given in detail below, with those of 1906:

	1905	1906
Telegraph and cable	$45,000,000	$50,000,000
Telephone	140,000,000	165,000,000
Electric light	135,000,000	175,000,000
Street and other railways	325,000,000	360,000,000
Isolated plant supply	75,000,000	100,000,000
Miscellaneous services	25,000,000	40,000,000
	$745,000,000	$890,000,000

To the unpracticed observer some of these items may look high, but none of them show heavy percentage gains over the authentic figures of 1902. In that year the street railway earnings were over $250,000,000, and a steady 10 per cent gain would show nearly $370,000,000. As to telephony, 5,000,000 subscribers at $30 a year would show $150,000,000, but the average yield is higher than that per station. The revival in electric light in 1905-6 has been enormous, and the increases have been heaviest in the largest systems. Hence, taking all things into consideration it would look as though the American public paid out in 1906 for its electrical goods and service an amount somewhere in the vicinity of $1,150,000,000. It seems quite probable that the grand total will reach the value of $1,250,000,000 during the year 1907.

ELECTRICAL POWER TRANSMISSION.

A fairly complete continuous record has been printed in these columns of the notable electrical power transmission plants which have been put into operation during the year just gone. It has been a year of activity, while lacking in any particularly sensational features. The abnormally high price of copper, unprecedented in the history of electrical enterprises, has had some effect in checking new plants, though the great and general prosperity evident everywhere has lessened the force of this difficulty. The increasing use of aluminum line wire has been a factor in the situation in spite of difficulty in securing deliveries. In general methods there has been no material change. The apparatus used has been that already familiar, and the chief event of the year has been the actual reaching in commercial practice of the 60,000-volt limit which in the past has been merely approximated, or touched in experimental service. No plants for higher voltage have gone into active service, though transformers made in contemplation of higher pressure have been shipped. It may take a year or two of trials at 60,000 volts and thereabouts before any considerable increase is tried. In matters of construction the chief tendency has been toward longer spans, whether in ordinary pole lines, which have been spanned out of 300 ft. or so, or with steel towers set at double this distance. The tower construction has been freely used and appears thus far to have given good results. In insulators the tendency has been away from the enormous structures of a few years since toward carefully designed insulators of moderate dimensions and of high-grade porcelain or special insulating composition. Some experiments have been made looking toward insulators for carrying the wires in suspension, but the experience thus far has been too limited to allow definite conclusions to be drawn.

On the hydraulic side there has been a maximum of activity at the moderate heads. There is a tendency, natural enough at present, to work up powers of the less sensational class, and to plan for the proper utilization by storage and by the installation of auxiliary plants. We have recently described some striking examples of such practice. Much of the recent power transmission has been for railway service with steam stations, equipped with turbo-generators. Such generators are conspicuous, too, in auxiliary plants for which they seem to be admirably suited. As to distances of transmission, the year's practice has been conservative, and the great California network still holds the record, and is likely to do so for some time to come, since great powers in a region where coal is high in price are at present fairly well utilized. The huge Victoria Falls scheme with its 700-mile transmission has been actively discussed, and at one time seemed to have awakened into real activity. Later reports do not indicate the likelihood of anything sensational in that region at present. Niagara, which might have been the source of record-breaking transmission, seems by press of local work and the weight of somewhat sentimental objections to further utilization, to be, temporarily, at least, in the background so far as long-distance work is concerned.

Very little new has appeared in the way of apparatus; even the single-phase power motors that have been bidding fair to make an impression, having taken a very minor place as yet. Lightning preventive apparatus, always a subject of interest in transmission work, seems to have come to a standstill in development, both here and abroad, although much is claimed for the recently announced electrolytic arrester in respect to its effectiveness in operation. Doubtless before the expiration of the present year the experience with this arrester in service will justify an expression of definite opinion as to its bearing on the final solution of the protective problem. On the whole the entire showing for the year is one of progress along strictly canonical lines. The only notable diversion has been the interest shown abroad in transmission at constant current, strongly urged by some authorities in connection with the Victoria Falls scheme. We have not learned, however, of any notable increase in the size of the units available for such work, and until much progress is made in this particular the system is under a severe handicap. For the present at least the ordinary methods seem likely to retain their supremacy.

The Electric Railway Situation.

Decidedly the event of the year has been the initiation of the electric service in the terminal work of the New York Central. As there was every reason to expect, the results have been encouraging, and there is a strong probability that the example will be a fruitful one. Lacking in any distinguished novelty of method, the installation, as we have already made our readers aware, is beautifully worked out in its details, particularly with respect to the locomotives. Of greater interest from an engineering standpoint is the alternating-current installation of the New York, New Haven & Hartford Railroad, unhappily not yet in commercial service. Engineers are divided in opinions concerning this equipment, individual judgments varying all the way from epoch-making innovation to cold bluff. We certainly do not consider it the latter—to the former it has got to make good its title by performance. One thing is pretty evident, however, that it is being watched with a good deal keener interest than attaches to the New York Central operations, since the former may be a general solution of the railway problem, while the latter, however successfully operative, is admittedly a special solution. Many a railroad manager has tucked away in his files reports on electrification of important lines that are waiting for the results achieved by the New Haven locomotives. Of interest in this connection are the Continental experiments with locomotives of the Ward Leonard type, and with high-voltage locomotives on the three-wire, self-contained system. Heavy electric traction will not get very far on the third rail, 600-volt basis, and if the advocates of direct current at higher voltage have the courage of their convictions they will hasten to get busy on the needed improvements.

Meanwhile the regular work of large interurban construction has gone steadily on, resulting in several notable roads of which the unfortunate Atlantic City line is one of the most striking. In the West there has been a steady programme of extensions, and an increasing approximation to railroad types and methods. In fact what with sleepers and dining cars, freight traffic and fully equipped terminals, it would take some degree of imagination to draw an operative distinction between the system with steam engines and that with electric motors. The latter are certainly playing a conspicuous part in general transportation wherever the former have been unable to suppress their competition. The rolling stock of electric lines is settling toward a few well-defined types, and the only noticeable tendencies are toward larger motors and the adoption of motor cars operated from one end only and turned around like locomotives, in changing direction. This again is definite following of railroad precedents. The methods of train dispatching and the signal systems of electric lines have also been developed along ordinary railroad precedents, to the general lessening of serious accidents. The fact is that with the lighter trains and relatively more powerful braking the electric road with equally careful employes ought to make a better record for safety than the steam road, so far as injuries to passengers are concerned. The 100-mile-per-hour electric road has not drawn appreciably nearer, in spite of the combined efforts of promoters and too-gullible reporters. As we have many times intimated, this is rather a matter of politics and high finance than of engineering. Physically the task involves now no serious difficulties, but railroad interests look with aversion upon anything that would make a general improvement in passenger traffic imperative. One has but to consider the possibilities of fast suburban service about the metropolis to realize how vast a change for the better could be made. We look forward in the beginning year with hopes that the high-speed electric road may not much longer be delayed.

It is instructive to note that previous to the year just ended the several steam railroads that had adopted electricity as a motive power did so on account of local conditions, which rendered the presence of the steam locomotive extremely objectionable, or the operation by electricity singularly advantageous. In the case of the early electrification of the Baltimore & Ohio Railroad at Baltimore the relative economy of steam and electric locomotives was of negligible importance, the determining factor being the elimination of smoke. Likewise, in the present electrification around New York City the problem is one that practically necessitates the suppression of the portable boiler house within the tunnels. To the Atlantic City-Camden Railroad belongs the distinction of having first adopted electric traction voluntarily. However, in the case of the Erie Railroad the favorable location of the electrified branch with reference to a source of cheap energy as found in Niagara Falls was the one thing that rendered the substitution of electric motor cars for steam-driven trains so very desirable from the standpoint of economy in operation. Doubtless the near future will witness the general adoption of ordinances by such places as Washington, Baltimore, Philadelphia and Boston tending towards the suppression of the portable boiler house, and thereby enforcing the substitution of electricity for steam as the immediate propelling agent of both freight and passenger cars. The real active factor in the suppression of the steam locomotive has been and will continue to be for some time the obnoxious smoke. The decreased cost of operating, the increased speed for short hauls, and the general improvement in the service and efficiency of the rolling stock will serve as powerful inducements towards the extension of electric traction throughout the whole territory at present covered by the steam roads.

EXPORT TRADE EXPANSION.

Striking as was the growth of electrical business during last year, it was certainly nowhere more remarkable than in the export trade. This has seen a steady increase of late years, but the rate now seems to be accelerating. The figures are at least worthy of passing comment, and are a cheerful indication that the home demand, immense as it has been, has not caused the manufacturer to neglect his foreign market. After all, the only way to retain such markets is to stay in them, and it is poor policy to secure a foothold and then abandon it.

The full data for the twelve months of 1906 are not yet available, but it is probable that the showing for the ten months reported upon by the Department of Commerce and Labor will be maintained throughout the whole year. The export of electrical instruments for October was almost double that of a year ago, the increase being from $454,224 to $863,287. This is a splendid gain, but it is equalled by the contrast between the ten months of 1906 and 1904. In the earlier year these exports reached $3,470,835. Last year, in the same period, these amounted to no less a sum than $6,803,754. A business with foreign consumers that can thus be doubled inside of two years is certainly well worth sedulous cultivation.

The gain in heavy electrical apparatus is also highly satisfactory. Last October the amount was $743,749, as compared with $527,669 in 1905. This is a sharp gain. The ten month periods are also good in their showing. In 1904 the amount was $5,342,064; in 1905 it was $6,021,212, and in 1906 it reached $7,010,008. Thus the total of electrical instruments and machinery was $13,813,762. At the same rate, the total for 1906 will be $16,576,514, and it is safe to assume it will come somewhere near that encouraging amount.

THE FAN MOTOR THE YEAR ROUND.

Recent developments are placing the fan motor as a very important source of all-the-year-round revenue for central stations, even in latitudes and locations where their operation to give cooling breezes is not necessary except in summer. In fact it is a question whether, in the future, in northern latitudes, more fan motors will not be in operation on the lines of a progressive central station company in winter than in summer. The use of the fan motor placed in the air intake of a hot air furnace to force circulation as described and commented upon editorially in the December 1 issue of the ELECTRICAL WORLD is undoubtedly destined to be one of its most important and generally useful applications. Now comes another ingenious scheme as reported from Janesville, Wis., by Mr. P. H. Korst elsewhere in this issue, namely, that of using cold air circulation instead of ice for keeping ice boxes cold in winter. Of course, the latter application is somewhat limited, as the majority of small ice users have no difficulty in keeping things cool in winter without artificial circulation of cold air, while, on the other hand, the very large users cannot always safely depend on varying outside temperatures for cold storage purposes. There are, however, a good many small stores, restaurants and meat markets in northern latitudes which might make use of this scheme. The fact that considerably more heat can be extracted from a steam radiator in a room by circulating the air through it with a fan motor has been known for a long time, but might well be more extensively advertised. Its use in very cold weather to keep frost off of show windows is another application which the progressive central station solicitor will be pushing about this time.

THE PRIME-MOVER.

While the past year has witnessed no startling changes or innovations in central power station practice, there have not been lacking indications of progress along various definite lines. As regards fuel for steam boilers, the situation has remained unchanged during the past several years. Coal remains the standby with natural or liquid oil fuel as a successful competitor where local or special conditions may justify its use. The use of liquid fuel in fact has been for some years a commercial rather than an engineering problem. The conditions for its successful and economic use have been carefully studied by engineers and all factors of the problem are now well in hand. Considering, however, the fact that in most parts of the world the present prices for oil fuel are near or above the margin for economic competition with coal, that long-time contracts cannot be made for such fuel at prices representing economic substitution for coal, and in view, furthermore, of the limitation of oil fuel in points of available distribution in comparison with coal, it is not surprising in spite of its many points of advantage, that oil fuel has, during the past few years, made but slight progress in competition with coal as a fuel for central station service. On the other hand, in special localities as on the Pacific Coast, where oil may be obtained at prices equivalent for steam producing value to coal at $2.50 to $4 per ton while actual coal rules from $6 to $7 and upward, it is not surprising that oil should be considered as the normal fuel, and that all problems of power plant design, installation and operation should take the use of oil fuel as a point of departure. These general conditions will continue so long as our use of steam fuel occupies its present relation to power plant service, and the use of coal or oil will be determined primarily by the economic conditions of the case.

In the matter of steam generators little need be said, as the practice of the year has continued to confirm the use of the large, straight tube type of water-tube or sectional boiler. Regarding steam prime-movers, the field of power plant service at large still remains divided between the reciprocating engine and the steam turbine. The latter has, however, made decided gains in the field of electrical central station service, while the former still holds by far the preponderant place in the remainder of the field of steam power plant practice. In the field of large electrical central station practice in particular, the use of the turbine may be said to have acquired definite status as the normal or standard form of prime-mover. As between the two forms of prime-mover no new arguments have been adduced and no new demonstrations forthcoming. Both still remain in the same class as regards economy, and the advantage of uniformity of angular velocity is met by builders of reciprocating engines with guarantees of performance adequate for all ordinary demands. The various relative advantages and disadvantages under size, high angular velocity, first cost, maintenance, etc., and which are well known, remain as in the past, and many power plant engineers now consider its advantage for electrical central stations is not by reason of any one feature alone, but due to the general balance, and taking into

account all factors entering into the final cost of the output. These conditions seem likely to continue so long as the general factors in power plant service have their present values, and in particular so long as steam continues to serve as the carrier of heat in its transportation into mechanical work. Some progress has also been made in the adaptation of the so-called low-pressure turbine for use with non-condensing reciprocating engines. Such forms of turbine are designed to run on the exhaust of the reciprocating engine and thus without change in the original prime-movers the lower temperature of the steam cycle is extended down to the lower temperature of the turbine, thus improving in marked degree the efficiency of the cycle as a whole. It may be pointed out in passing that due to the mechanical differences in two such types of prime-mover connected together on the same steam cycle, they cannot be both mechanically connected to the same load. At best such hybrids must be considered as justified only by special conditions, and presumably they represent only a passing phase in the gradual adaptation of the turbine to the demands of power plant service. So far as the use of superheated steam is concerned, Continental Europe is still in the lead, especially with reference to its use in reciprocating engines. The advantages of the use of superheated steam with the steam turbine are, of course, well understood, and the use of such steam is frankly accepted as the normal condition for turbine operation. With the reciprocating engine, although the possible gain is quite as much, the mechanical difficulties standing in the way of its realization are more serious, and little progress seems to have been made during the year in the improvement of our practice in this respect.

The various types of gas engine or internal combustion engine, to use the broader phrase, have steadily extended their usefulness during the year and now occupy definitely a not unimportant part of the field of power plant service. The important economic question with the engines of this type is the fuel. Thus, while gasoline is available for the power plant, an automobile or small pleasure boat, or even of a small industrial plant where the power item is small, it could not, of course, be considered for a moment where power is the main output. At the present time blast furnace gas, representing a residue, and producer gas of one type or another and derived from coal, represent the two gaseous fuels available for the development of power on anything approaching a commercial scale. The use of the former is limited by local conditions so that producer gas stands as the present typical gaseous fuel for prime-movers of this type. The field of advantageous application for such engines seems certain to widen, and at the present time there are perhaps no questions of higher interest to the power plant engineer than those connected with the possibility of the development of internal combustion prime-movers in such form as to be satisfactory for large electrical central station service. In such connection the thought naturally turns to the gas turbine, but the practicable prime-mover of this type seems as far away as ever. Present types of reciprocating gas engines in units adequate for operation of large electrical generators are as yet few in this country, but the extension of the satisfactory use of the internal combustion engine to the operation of electrical central stations of moderate size, is already an accomplished fact and its further extension along the same line seems a foregone conclusion.

Under the general head of auxiliary power plant equipment little need be said. The general methods and appliances available remain the same as for the past few years. More and more attention, however, is being given to the combination of such appliances in such manner as to make for the highest plant economy. Questions of heat balance are forcing themselves more and more prominently upon the engineer, and he is coming to realize that he must scrutinize his energy accounts and strike his energy balance with all the care of a bank clerk with his cash account, and furthermore that he must exert his most strenuous efforts to bring about the reduction of those streams of energy outflow in forms which are non-available and thus increase those in forms which represent a direct useful product—mechanical work, electrical energy, heat or whatever other form it may chance to take.

Central Station Development in 1906.

A year ago we ventured to predict the beginning of a new era in central station development along commercial lines, and the prediction has been abundantly verified. We are not among those who have been pessimistic as to the future of this important part of the electrical field, although we have realized more fully than some who are not closely in touch with it how small a per cent of the possible service to a community the average central station company has been performing in the past. The past two years, and especially the year 1906, have seen a great waking up in central station circles as to the possibilities of the business. This activity has taken tangible form in the establishment by many companies during the year of more extensive business-getting departments and the inauguration of better business-getting methods than ever before. Moreover, central station companies have been hunting more earnestly than before for possible new applications of electric current likely to prove good revenue producers and have been giving more earnest attention to the question of proper systems of rates which will enable them to get and retain certain desirable classes of business. It is notable that such subjects as solicitation and advertising are now prominent on the programme of all central station associations.

The fact is a new branch of the central station business is being rapidly created, namely, the business-getting branch. The companies which were in the advance guard and have maintained such organizations for some time are finding themselves being robbed of some of their best talent to supply the demand which exists the country over for men to do this class of work. The profession of central station solicitor hardly existed outside of a few large cities two years ago. One year ago the demand for such men was beginning to be very active, and at the present time the outside supply is exhausted, and this part of the personnel must be educated locally from raw material. Along with the establishment of departments for getting and retaining business has sprung up the necessity for better illuminating engineering. It is now realized by the best minds in the profession that central station employes who deal directly with customers should at least be well grounded in the designing of illumination to produce the best results for the money. In fact, no small percentage of the membership of the Illuminating Engineering Society which has been formed within the past year has come from central stations.

Technical advances in the electric lighting art have more than kept pace with the advances in business methods and policies. Although the new high candle-power, high-efficiency, carbon filament incandescent lamps were brought out in 1905, it has been mainly in 1906 that they have been introduced in actual practice. The results seem to have been most gratifying. There have been difficulties in getting sufficient quantities of these new lamps to meet the demand or their introduction would have been more rapid than it has been. During the past year this type of high-efficiency lamp has been brought out in sizes as low as 50 watts as a substitute for the standard 16-cp lamp, and also in small units for series street lighting purposes; but here also the inability of manufacturers to supply lamps in large quantities until manufacturing facilities are better organized to turn out the new product has prevented their more rapid introduction, and the larger central station companies furnishing free renewals have been so far unable to accumulate enough of a supply of the new lamps to make it possible to inaugurate a policy of putting them out on a free renewal basis. The past year has also seen the placing of the tantalum incandescent lamp on the American market for direct-current circuits at a price considerably below that which was predicted for it with foreign prices as a criterion. The disappointment that was felt over the failure of the tantalum lamp to give a satisfactory life on alternating-current circuits has been compensated for by the announcement of the tungsten lamp with a consumption far below the tantalum lamp and a satisfactory life both on direct-current and alternating-current circuits.

In fact, the results obtained from tungsten lamps so far, both in Germany and in the United States, seem to make it unquestionable that this lamp or something better in the way of an incandescent lamp will revolutionize the electric lighting industry within the next few years. With an incandescent lamp like the tungsten, which gives an efficiency nearly three times that of common carbon filament lamps of to-day, there seems to be no question that electric lighting is sure to see a great expansion, to provide for which central stations must be prepared. Further than this, it looks as if the incandescent lamp with the recent increases in efficiency added to all its well-known conveniences, would drive the ordinary carbon arc lamp out of the field. It is certainly a matter of congratulation all around that the great convenience of the exhausted bulb incandescent lamp is now to be coupled with an efficiency considerably better than that of the ordinary carbon arc lamp of to-day.

We do not look for any reduction in central station revenues from the advent of the metallic filament lamp provided the proper preparations prior to its commercial introduction are made. Quite the contrary, we believe it will prove one of the finest business stimulants ever given to the central station industry. In the first place, it will be impossible to obtain these high-efficiency lamps fast enough to work any very sudden revolution. In the second place, the majority of customers, instead of reducing their lighting bills with the higher efficiency lamps, will spend as much or more money and have incomparably better light. The first point is being amply demonstrated at the present time in the case of the new high-efficiency carbon filament lamp. As the representative of a large central station company recently remarked to us: "It is easy enough to decide on a policy of furnishing these new lamps to our customers, but it is quite another thing to get the lamps themselves." The manufacturers cannot turn them out fast enough to make a revolution, and even if they could there is enough natural business inertia to prevent a wholesale change being made within a short time. It took years to introduce the gas mantle burner, although its efficiency as compared with the open flame was considerably higher than that of the tungsten lamp as compared to the old carbon lamp.

The prospects for many of the smaller electric lighting companies have brightened considerably in 1906. A number of companies have demonstrated by practical trial the feasibility of supplying power to all the small towns within a given radius over inexpensive transmission lines from a reasonably economical power house at some central point. This movement when it spreads, as it undoubtedly will, means the salvation of a lot of small plants which never could be made profitable operated from separate steam plants. Some companies have been making notable progress in securing power contracts from manufacturing concerns. This has been made possible by the increase in efficiency of generating plants and also by the realization of certain important facts by both the central station manager and the isolated plant owner. The central station manager has come to realize the great difference in cost of supplying electricity ten or twenty hours a day as against one or two hours as in commercial lighting, and has made rates accordingly. The isolated plant owner has come to realize the actual cost of maintaining his steam plant. Residence lighting, which by too many companies has been neglected, is coming to be considered in its proper place as an excellent class of business when enough customers are secured per block to prevent interest on distribution systems from eating up the profits. In connection with residence business the electric flatiron has been introduced in large quantities by many progressive companies and will undoubtedly see much more extensive introduction in 1907. One iron manufacturer alone expects to turn out not less than 50,000 the coming year. Electric heating and cooking devices other than the flatiron have not found rapid introduction yet, but in another year or two we think a different story can be told. There is too much inherent merit in some of these devices to allow them to be dormant when the central station interests are prepared to handle them intelligently.

A review of the central station field in 1906 would be incomplete without a reference to the Co-operative Electrical Development Association, and the excellent work which it has performed. The two great weaknesses of the central station have been in relation to publicity and its methods, and the systematic solicitation of business. The excellent campaign of education which the association has carried on to correct these failings has been very effective, as indicated by the figures given elsewhere of the great increases made during the year in expenditures for advertising and in additions to the business-getting staff of central stations. While all of the increase may not be ascribed to this one source, the great amount of instruction as to specific methods which it has disseminated through its publication has undoubtedly been a potent factor. It is most sincerely to be hoped that the manufacturing interests so largely benefited by its work will continue to foster the association and by liberal grants enable it to broaden the scope of its activities.

Co-operative Electrical Development Association.

A meeting was held December 13 in New York for the purpose of still further widening the scope of the Co-operative Electrical Development Association. Representatives were present from the more important electrical interests of the country, and the aim of the association and the results thus far achieved in its work were very thoroughly discussed. The great benefit of the association to the electrical industry was testified to by many speakers representing widely different lines of business. Committees were appointed to extend the organization of the association, one being a committee on constitution and by-laws, another on membership and assessments, and a third on commercial programme.

Mr. Robert Crouse, in a report to the meeting, stated that thus far the total amount expended by the association in carrying on its work, was $28,256.41, and that in addition thereto about $60,000 had been expended by other interests working in co-operation with the association.

As indicating the results achieved through the activity of the association, it was stated that during the last year 96 central stations had organized new business departments, only 58 such departments having been previously in existence; 165 central stations added 331 solicitors during the year; 193 began advertising last year, as against 17 previous to that year, and 232 began newspaper advertising as against 29 the previous year; 195 increased their advertising, 43 of which reported their increase to be $42,250; 165 opened up display rooms, only 38 having existed previously, and 188 installed electrical signs, as against 8 the previous year. It is estimated that over one-half million dollars was expended by the central stations reporting to the association, in going after new business. As another indication of the work of the association, it was stated that the gain in the incandescent plant business during 1906 was 25 per cent over 1905, as contrasted with a gain of 8 per cent in 1905 over 1904 and of 5 per cent of 1904 over 1903.

Public Utilities Association of Indiana Organized.

A number of electric light company representatives from different parts of Indiana met at the Claypool Hotel, Indianapolis, December 27, 1906, and organized the Public Utilities Association of Indiana. The call for the meeting was issued at the request of several central station men of the State by Mr. B. V. Hubbard, secretary and manager of the Public Service Company of Mooresville, Ind. Unfortunately, owing to the slipshod methods of the hotel management and the presence of another large convention in the hotel at the same time, it is believed that a number who came to the city to attend the meeting were unable to find it. An organization was perfected, however, and a meeting will probably be held some time in January. The companies responding to the call either by representatives at the meeting or by letters applying for membership and enclosing checks for initial expenses of organization were the following:

Evansville Gas & Electric Light Company, W. B. McDonald, secretary and manager; Bicknell Light & Power Company, A. L. Brocksmith, manager; Citizens' Water & Light Company, of Greenwood, J. A. Craig, secretary and manager; Elwood Electric Light Company, S. B. Harting, manager; Ligonier Electric Light Company, W. S. Draper, manager; Marion Electric Light & Heat Company, George N. Tidd, manager; Knox Electric Light & Power Company, Thomas A. Grist, owner; Clinton Electric Light & Power Company, J. W. Robb, secretary and manager; Rockport Water Works Company, A. H. Kennedy; South Bend Electric Company, F. A. Bryan, secretary and manager; Spencer Electric Light plant, William S. Mead, owner; Muncie Electric Light Company, George N. Tidd, manager; Plymouth Electric Light plant, C. D. Snoeberger, president; Putnam Electric Company, Greencastle, John G. Bryson, manager; Noblesville Heat, Light & Power Company, C. E. Layton, superintendent; Covington Light & Water Company, H. C. Yount, secretary; Public Service Company, Mooresville, B. V. Hubbard, secretary and manager; Arcadia Electric Light plant, J. A. Shunk, Peru, owner; Citizens' Water & Light Company, Winchester, C. R. Semans, secretary and manager.

The first meeting was held in the morning at 11.30. A committee on organization and incorporation was appointed, consisting of Mr. J. A. Shunk, of Peru, and Mr. William S. Mead, of Spencer. A committee to draft constitution and by-laws was appointed consisting of Dr. J. A. Craig, of Greenwood, and Carl R. Semans, of Winchester. Mr. J. R. Cravath, western editor of the Electrical World, was asked to address the meeting on the methods of conducting similar organizations in other States with which he was familiar and the advantages derived therefrom. He spoke briefly on the electric light associations of Ohio, Michigan, Illinois, Iowa and Texas, showing the various methods of conducting associations in these different States and their value to the members as a clearing house of information and in keeping them posted on proposed legislation affecting their properties. The meeting adjourned until 2 p.m., when the committee on organization and incorporation came prepared with incorporation papers drawn up for signature, and the committee on constitution and by-laws submitted proposed forms. The constitution and by-laws as finally adopted provide for an annual meeting at which five directors shall be elected. These directors shall select a president, vice-president, secretary and treasurer from among their number, who shall be the officers of the association. Regular meetings are to be held semi-annually the second Thursday in May and December. The name is to be the "Public Utilities Association of Indiana" and its membership is to consist of owners or officers of companies operating public utilities in the State of Indiana. There was considerable discussion as to whether the association should be confined to electric light men or include other interests. The call had been practically confined to electric light companies and it was evidently felt that while it would probably be largely an electric light association, it was not best to shut out the other allied public service interests if they desired to come in. No associate membership is provided for. There is to be an advisory board to further the interests of the association by getting in new members and arousing interest in the association. This advisory board is to consist of one member from each of the thirteen congressional districts of the State. Initiation fees are $5 per year and annual dues are graded according to the legal classification of the city in which the company is doing business, ranging in steps from $30 for companies in cities of the first class, to $10 for companies in cities of the fifth class, and $5 for companies in towns.

The board of directors was then elected consisting of Mr. B. V. Hubbard, of Mooresville; J. A. Shunk, of Peru; C. R. Semans, Winchester; William S. Mead, of Spencer, and J. A. Craig, of Greenwood. The meeting then adjourned and was immediately followed by a meeting of the directors, at which officers for the board and for the association to serve the first year were elected as follows: B. V. Hubbard, of Mooresville, president; William S. Mead, of Spencer, vice-president; J. A. Shunk, of Peru, secretary, and Dr. J. A. Craig, of Greenwood, treasurer. After the selection of a part of the advisory board the meeting adjourned, subject to the call of the president and secretary.

Telharmonium Demonstration.

At a reception tendered by the trustees of the American Museum of Natural History and the New York Academy of Science to the members of the American Association for the Advancement of Science on December 29, the Cahill telharmonium system furnished music continuously during the evening. Connections were made to the distributing circuits along Seventy-seventh Street and thereby the requisite superposed currents were obtained from the "central station" at Thirty-ninth Street and Broadway.

The American Association for the Advancement of Science.

Beginning on December 27, 1906, and continuing until January 2, 1907, the American Association for the Advancement of Science and several affiliated scientific societies held their mid-winter sessions at Columbia University in New York City. This, the fifth, of the convocation week meetings, proved of much general interest and many subjects of importance were discussed. The registration at the headquarters showed that more than 900 members of the association were in attendance at the meetings of the ten different sections. In one section alone, namely section E, on geology and geography, there were listed a total of 94 papers. The lists of the other sections were not so lengthy, so that more time was allowed for the discussion of the papers. Below are given brief abstracts of a few of the papers read before the sections dealing with physics, mechanical science and engineering.

The first paper presented in the section relating to mechanical science and engineering was one by Prof. Comfort A. Adams, Jr., on polyphase power measurement. This paper gave an extremely simple proof of the accuracy of the two-wattmeter method of measuring three-phase power, and showed in what way the direction of flow of energy can be determined at once without the usual trial and elimination method. The method is based on the fact that any one of the three leads may be considered as a return circuit for the current in the other two leads. Having placed the arrows on the individual leads in accordance with this consideration, the author then connects the two wattmeters symmetrically just as though he were endeavoring to measure power in two separate direct-current circuits having a common return. The symmetrical placing of the meters affords at once the desired information concerning the direction of flow of energy.

Prof. W. H. Bristol gave a working demonstration of a new electric furnace which has been designed particularly for tempering tools and other small articles. The heating element of the furnace consists of resistance wires insulated with asbestos. The novel feature embodied in the furnace consists of a quartz retaining vessel for the substance to be heated. The quartz is capable of withstanding the highest temperature desired in the furnace, and it is not injured in any way by rapid heating or cooling. The author stated that temperatures as high as 2,000° can easily be obtained without injury.

In his paper on tests of a producer gas engine Prof. G. W. Bissell gave much valuable information concerning the cost of operating a small electric light plant with producer gases. In a certain station at which the anthracite coal from which the gas is obtained costs $6 per ton, it was shown that the total fuel cost, including all stand-by losses for 24 hours, is 1.23 cents per kw-hour. During the test the output was 156.9 hp for six hours. At this load, which was 104.2 per cent of the rating of the equipment, the thermal units represented in the break horsepower-hours equalled 19.67 per cent of the units in the coal; that is, the overall efficiency was 19.67 per cent. At a load of 26.8 per cent of the rating the efficiency was 15.69 per cent, while at a load of 55 per cent the efficiency was 17.56 per cent.

Mr. C. J. H. Woodbury gave an illustrated talk on telephone line engineering, which emphasized the numerous difficulties which must be overcome by the telephone engineer in erecting lines in the different parts of the country. He described at great length the means employed for anchoring poles in swampy places and also along the tops of mountains, where snow and sleet are encountered. Although many types of manufactured poles have been used, the fact remains that wooden poles are the best. Cement poles have not proved as good as wooden poles. The magnitude of the problem connected with poles will be appreciated when it is known that the Bell companies use about 1,000,000 poles per year. The life of each pole is determined by the rapidity of decay near the surface of the ground. To prevent decay each pole is given a certain treatment. It has been found that a treated pole breaks ordinarily 7 to 9 ft. above the ground, showing that the treatment not only prolongs its life, but increases its strength. The breaking of poles is frequently caused by the synchronous swinging of the wires, and there are cases where the poles break almost at the top, due to such swinging. The best practice where telephone wires cross high-tension transmission circuits consists in placing a high pole on either side of the transmission circuit and making the span between these poles so short that a broken telephone wire cannot possibly reach the high-tension wires. In comparing iron and copper telephone circuits, it was stated that iron wire lasts about four years and costs about 4 cents per pound, while copper, which costs about 20 cents per pound, lasts indefinitely. So valuable is copper scrap that in taking down an old copper circuit it does not pay to roll up the wire carefully because the old wire can be sold as junk at not over 2 cents per pound less than new wire can be obtained. It was stated that of the 7,500,000 miles of Bell telephone circuits, about 55 per cent is underground. As illustrating the difficulties encountered in placing manholes in cities, the author stated that along the duct system in New York City it was possible to use only one standard manhole between Fourteenth Street and the Battery; each of the other manholes had to be designed for the particular location in which it was used.

A series of three papers presented by Prof. E. B. Rosa dealt with the common subject of mutual inductance. The author showed that according to an experiment with which the name of Lorenz is associated, the mutual inductance of a circle and a coaxial helix can be determined by rotating a copper disc mounted within and coaxial with the helix. In this case the inductance is found from the ratio of the product of the current and the number of turns in the helix and the speed of the disc, divided by the radius of the disc. The formula which allows the inductance to be computed with absolute exactness is extremely complicated, but an approximate formula which can be derived without difficulty allows the inductance to be determined without appreciable error. An absolute electrodynamometer which depends upon the mutual inductance of two coaxial helixes has been designed by Ayrton and Jones. In this dynamometer a central helix is acted upon by two halves of an external helix, one half tending to pull the internal helix upward and the other half to push the internal helix upward. The force is counteracted by the action of gravity upon a certain weight. The mutual inductance of the coils having been determined, the value of the current flowing within the helixes can be ascertained from the movement of the weight. The inductance can be computed with an error not exceeding one part in 1,000,000. The second paper by Prof. Rosa described the use of mutual inductance for calibrating ballistic galvanometers. The author stated that of all ballistic galvanometers the D'Arsonval type is the best. For the calibration of such galvanometers it is desirable to use two mechanically superposed coils wound on the same spool. By measuring the current in one coil, it is possible to determine the flux interlinked with the second coil to which the ballistic galvanometer is connected. When the current in the one coil is interrupted the magnetic field discharges its energy into the galvanometer. The relation of the constant of the galvanometer to the current depends upon the mutual inductance of the coil. The third paper by Prof. Rosa showed in what way the mutual inductance of two coaxial coils can be computed.

A paper by Drs. F. A. Wolff and C. E. Waters dealing with the standard cells showed that both the Clark and the Weston cells are reproducible with an error not exceeding two parts in 100,000, and when properly set up they maintain a practically constant ratio for at least six months. A second paper by the same authors reported the results of tests showing that all samples of mercurous sulphate do not exhibit the same behavior, but that gray samples even after rotation for from 30 to 60 days remain in agreement within the ordinary cells to within .01 per cent.

Prof. H. C. Parker and Mr. W. G. Clark described the Helion lamp, the new high-efficiency illuminant, which is treated elsewhere in this issue.

Helion Filament Incandescent Lamp.*

By Prof. H. C. Parker and Walter G. Clark.

The Helion incandescent lamp is the result of several years of research work on the part of the authors in the Phœnix Physical Laboratories of Columbia University. The name Helion is adapted from Helios, and was adopted on account of the resemblance of the spectrum of the light from this filament to the solar spectrum. In some respects the filaments are quite remarkable, as they are not metallic, yet they can be operated at a specific consumption of one watt per candle at a temperature which readings on the Fery absorption pyrometer indicate is very much below the temperature of metallic filaments when operated at this consumption. The Helion filament is composed largely of silicon which is reduced and deposited, together with the other materials, under very exact conditions. The base which is being used at present is a special carbon filament, on which the necessary deposit is made. The filament is mounted within a globe which is then pumped out, much the same as with the ordinary carbon lamp. When current is applied, the first noticeable characteristic is the white light radiated from the filament at a current density at which the carbon filament would be radiating only red rays. The next characteristic is the whiteness of the light, and the high luminous efficiency of the filament at its normal current density, and next the overload or extra current which it will carry without breaking down. The filament, while not metallic in the proper sense, shows a metallic characteristic in that it is possible to fuse parts of it together very much the same as is done with a metallic filament. This is demonstrated by the filament shown in Fig. 1,

FIG. 1.—SELF-WELDED LAMP FILAMENT.

which broke, and then fused together where the parts came in contact.

In early experiments with the filament it was noticed that a point of maximum candle power could be reached, and that further increase in current apparently did not result in a proportional increase in light. This has been borne out by pyrometer measurements,* which are shown on the curve in Fig. 2 It will be noticed that the candle power increases with the temperature in practically a direct ratio up to a temperature (black body temperature) of approximately 1,720 degrees, at which point the curve flattens down, until it is practically flat at 1,800 degrees. In some experiments to determine the overload which the filament would carry, the power applied has been increased by 100 per cent after the point of apparent maximum brilliancy had been reached, the filament carrying the overload without rupture.

The curve of Fig. 3 shows the temperature-coefficiency of the filament which is at first negative; the resistance of the filament shown in the curve drops from 32¾ ohms at 1,125° temperature, to 26¼ ohms at 1,375°, then increases to 27 ohms at 1,720°, and has a slight negative coefficiency beyond this point. The test shown on this particular curve was made on a short section of a regular filament. It will be noticed that the change from the positive temperature coefficiency to a negative coefficiency, takes places at practically the point at which the ratio of temperature to candle power makes its greatest change, as shown in Fig. 2. The change occurring at this point would seem to indicate that a molecular alteration had taken place in the filament, but if this is so, it would appear that the same change occurs in a reverse order as the temperature is

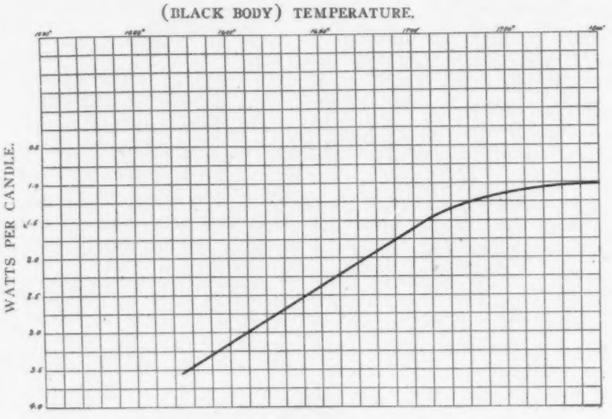


FIG. 2.—CONSUMPTION CURVE.

reduced, for when the filament is allowed to cool and power again applied, the same characteristics are observed.

The amount of overload the filament will withstand is well shown in the lamp illustrated in Fig. 4 where long copper wires were used to place a small loop filament into the middle of the lamp bulb. The current passing through the filament was raised to a point where the copper wire on one side fused, ran down, and now appears as a metal globule near the neck of the lamp. The cement terminals are intact, and a portion of the copper yet remains at each cement terminal, the copper having fused immediately at the cement covered terminal. The

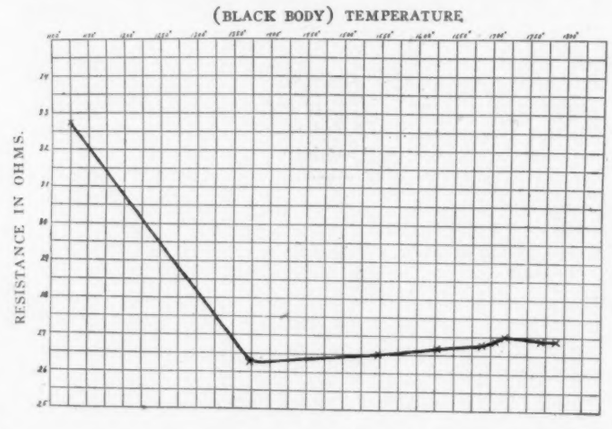


FIG. 3.—TEMPERATURE COEFFICIENT.

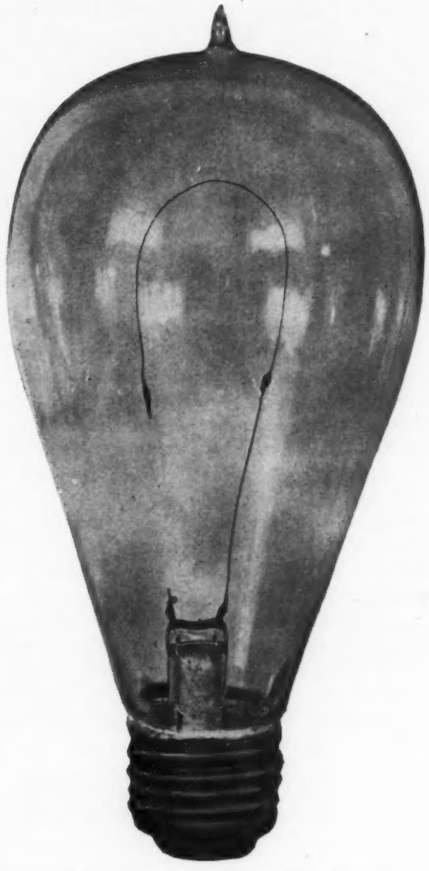
overload does not appear to have in any way injured the filament, which is still intact, and the only discoloration on the glass is a slight deposit of copper on the side near the fused terminal, there being no deposit from the filament on the glass, although the cross section of the copper wire is several times greater than the cross section of the filament.

The curve in Fig. 5 shows the relative intensity of light from a Helion filament and a standard make of carbon filament lamp at various wave lengths in the spectrum, each lamp being operated under normal conditions. The curve shown in Fig. 6 indicates the energy consumed by the same two lamps in producing this luminosity curve. It will be noticed that the Helion energy curve is the smaller one, while the luminosity curve is much greater than the carbon filament. The greatest degree of luminosity for each lamp appears at .58 μ. This

* Paper read before the American Physical Society at New York, Dec. 29, 1906.

result seems to be due to some characteristic of the human eye, because a Welsbach mantle, the open gas flame, and other sources of illumination so far tried, all give a maximum intensity at this wave length, and it would appear that the normal eye is most sensitive to this wave length, which is between the yellow and the green.

Sufficient time has not yet elapsed to give conclusive life tests on these filaments, but out of the few tested, eight lamps have shown lives of from 485 hours to 1,270 hours actual burning. The lamps tested were all lamps originally made for other tests, and some of them had burned for a great many hours



LAMP WITH RUPTURED TERMINAL.

before being placed on the life test, and had been tested for candle power at various consumptions, etc. All were made, mounted, enclosed in the glass bulbs, and pumped out at the laboratory where the facilities for mounting and pumping were not the best, so that this life test does not show as good results as will probably be secured on new lamps placed on life tests without being strained by the other tests to which these lamps were subjected. That the life of the lamps tested was controlled to a great extent by the previous treatment the lamps had received, the condition of the terminals, and the degree of vacuum attained, is indicated somewhat by the fact that the lamp which failed at 485 hours showed a decrease in candle power of about 15 per cent, while the lamp which ran 1,270 hours showed a drop in candle power of only about 3 per cent. Several of the lamps ran more than 700 hours, and a number of them showed an increase in candle power over the initial candle power during some portion of the life. One lamp which ran 735 hours showed a gradual increase in candle power which reached a maximum of about 2 per cent. Each lamp was started at one watt per candle power, and the filament in each case parted either at or near the cement terminals or anchor, which indicated either a condition of strain on the filament, or else that the cement acted upon the filament. In some cases it has been found that the cement which was being used at that time contained a low silicate, which combined with the filament and reduced its cross section near the terminal, causing the filament to part at this point. The lamp which ran 1,270 hours showed rather an interesting performance. The lamp was started at 37 watts and 37 candle power. At the end of 200 hours it began to show an increase in candle power, which increase continued until the candle power reached 40 at 400 hours, the wattage remaining practically constant at 37. At 400 hours the candle power began to decline and again

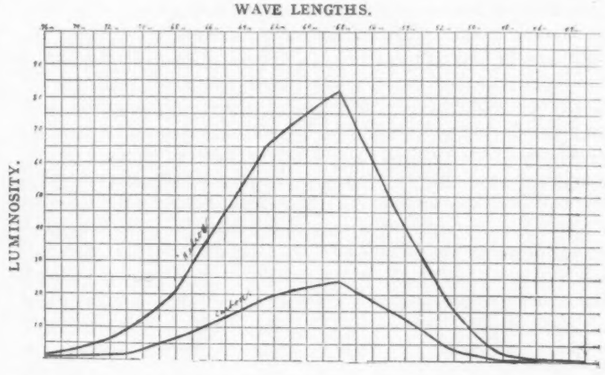


FIG. 5.—RELATIVE INTENSITY OF LIGHT FROM HELION AND CARBON FILAMENTS.

crossed the 37 mark at 500 hours. The decline continued at a very slow rate, and when the last reading was taken at 1,230 hours, the illumination had dropped to about 35.5 candles, and the consumption was about 36.5 watts. This lamp failed near one of the carbon terminals at 1,270 hours of continuous operation. The only blackness or discoloration on the glass, perceptible to the eye, was a ring of brown color around the lamp near the base and opposite the terminals. From observations made up to the present time, the high efficiency of the Helion filament appears to be largely due to selective radiation, as the filament reaches a maximum whiteness at a comparatively low temperature, after which an increase in temperature to the 1,720° point increases the intensity of illumination, but does not appear to make very much change in the color of the light; but with a carbon filament the color and quality of the light shows a marked change as the temperature increases. In making some comparisons with the carbon filament, they were run

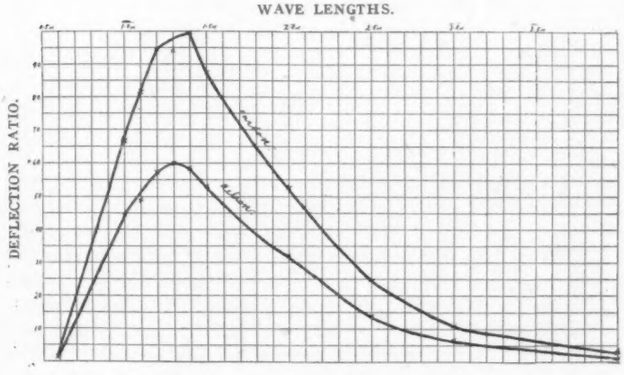


FIG. 6.—RELATIVE ENERGY FLOW FROM CARBON AND HELION FILAMENTS.

up in temperature to the point of disintegration, but even at this point the light was very much more yellow than the Helion filament at its normal working temperature. It has been found possible to make filaments as low as 30 candle power for present commercial e.m.f. of from 100 to 115 volts, at approximately the same length as carbon filaments. How much smaller unit it will be possible to make is yet to be ascertained.

Tungsten Lamp Patent.

Under the title "Manufacture of Luminant for Electric Lamps" a patent was granted December 25 to Mr. John Allen Heany, of York, Pa., on an incandescent lamp filament consisting of a metallic alloy of tungsten and of titanium or similar metal. The original application, of which that of the present patent is a division, was filed December 29, 1904.

The specification states that the invention relates to the manufacture of luminants for electric lamps made of very pure refractory metals, such as tungsten, titanium, zirconium, etc., or alloys of two or more of such metals, or of pure chromium, molybdenum, thorium, manganese, or alloys of such metals. Such luminants have properties heretofore unattainable, such as being ductile and capable of standing a much higher temperature than any form of carbon or the carbids of such metals and are more efficient than any hitherto known metallic filaments. They can withstand a much higher temperature and also convert the heat into light waves, and thereby have the properties of selective radiation. The above metals or osmium, cerium, niobium, tantalium and vanadium or boron and silicon are utilized either singly or mixed in a powdered form, as some of these powdered metals can be obtained by known processes more or less pure; or the pure oxides, hydrides, nitrides can be employed or metals in a very fine powder or in a colloidal state of the oxide or colloidal suspension of the pure metal and with the dry powder use a lubricant or binder, such as water or paraffin, to form or shape them. They are then baked in an oven to drive out the paraffin or water and in case the oxide is used the filament is reduced in pure hydrogen by external heat to the metal. The preliminary baking does not oxidize the metal, but merely strengthens it, and during this operation the binder is dissipated, leaving the filament formed of a refractory substance, strong, durable, and of good conductivity. The body is now heated by an electric current in a vacuum to drive out the hydrogen and to sinter or alloy the particles. If the filament is too large or rough, it may be rolled or drawn to the desired shape.

The present divided application is directed particularly to the production of an alloy of tungsten and titanium or an alloy of tungsten with some other metal.

It is well known in the art that when two metals in a finely-divided condition are mixed with each other and heated under certain conditions they form alloys, and it is also believed by some that alloys generally melt at a lower temperature than either of the component metals; but the inventor states he has discovered that certain alloys of these above-mentioned metals in various proportions are very stable at high temperatures and appear to have the properties of selective radiation in a vacuum. The resistivity, flexibility, strength and shiny surface of these alloys can be regulated by the proportions of the constituents and by certain manipulation.

As an illustration of a suitable process, finely-powdered pure titanium nitride, which may be made by passing pure ammonia gas over heated pure titanium dioxide, is mixed with an equal volume of pure tungsten trioxide, which is also finely powdered and squirted through a suitable die, there being added a small amount of paraffin or water to act as a lubricant, and the filament is then baked to drive out the lubricant. The filament is now heated by external heat, such as a gas flame, in a porcelain tube, through which an abundant supply of pure hydrogen is flowing for several hours, and the tungsten trioxide is by this treatment reduced to the metal, which remains mixed with the titanium nitride. The filament, after cooling, is removed from the tube through which the hydrogen is passing and mounted on the stem of the lamp. The bulb of the lamp is now exhausted and the filament is glowed at a bright temperature, care being taken that no vaporized oil arises from the pump into the bulb in order to prevent the formation of a carbide. By the action of the electrical current, which produces a very high temperature, the titanium nitride is dissociated and the nitrogen is pumped off while the titanium alloys with the tungsten. The filament shrinks both in cross-section and in length, and there results a dense shiny durable alloy filament of pure titanium and tungsten.

Another method consists in mixing titanium dioxide with tungsten trioxide and forming the mass into filaments by squirting through a die, there being added a small amount of water or paraffin; then driving out the water or paraffin by gently heating, and then reducing the filament, which now is composed exclusively of the two oxides mentioned, in the tube by hydrogen, whereby the tungsten trioxide is reduced to metal and the titanium is either converted into the metal or the suboxide, or a mixture of the two; the filament is then treated in a vacuum by an electric current, as above specified for the nitride and metal filament.

Various other proportions of the ingredients may be employed and excellent results may be obtained by using in place of the tungsten trioxide pure finely-divided tungsten up to as high as 95 per cent mixed with 5 per cent of titanium powder or powdered titanium nitride, or mixed with other refractory metal or metallic substance. The conductivity, strength and efficiency vary with the alloys of different metals, and good results may be obtained with a comparatively large percentage of tungsten alloyed with any of the above-named metals.

Following are the three claims of the patent: A filament for incandescent lamps consisting exclusively of a metallic alloy of tungsten and titanium in a dense shiny coherent state and homogeneous throughout.

A filament for electric incandescent lamps comprising an alloy of tungsten and a metal which is stable and capable of being incandescent at a temperature at which platinum volatilizes, said filament having a high point of fusion and being electrically conductive, and being stable at an efficiency at which a carbon filament, or a filament containing metallic oxide will rapidly disintegrate, and being dense and homogeneous and having a shiny metallic surface.

The process which consists of forming a filament composed exclusively of a compound of tungsten and a compound of titanium and reducing both compounds to their respective pure metals, removing the non-metallic component elements and alloying said pure metals, and shrinking said filament into a dense homogeneous shiny metallic alloy filament.

December Meeting of the A. I. E. E.

At the meeting of the American Institute of Electrical Engineers, held on December 28, 1906, Mr. Ray P. Jackson presented a paper discussing the phenomena of lightning and describing a new form of lightning arrester which employs an aluminum cell in connection with a spark-gap. The paper was discussed by Mr. Ralph D. Mershon, Dr. C. P. Steinmetz, Prof. E. E. F. Creighton and Messrs. Percy H. Thomas, H. B. Alverson and P. M. Lincoln. An abstract of the paper together with the discussions following its presentation will be given in a succeeding issue.

Central Station Accounting.

Central station accounting is again being actively taken up by the National Electric Light Association, and a strong committee has been appointed by President Williams to report at the 1907 convention of the association. The members of this committee are: H. M. Edwards, of the New York Edison Company, chairman; A. S. Knight, of Boston; G. W. Curran, of the United Gas Improvement Company, Philadelphia; C. N. Jelliffe, of the American Light & Traction Company, New York; and Paul R. Jones, of Henry L. Doherty & Company. These gentlemen have a very thorough knowledge of the subject, and a valuable addition to the work already done in this line by the association may be looked for.

CURRENT NEWS AND NOTES.

NEW YORK TO BOSTON.—According to a statement made by Vice-President Edward G. Buckland of the New York, New Haven & Hartford Railroad, it is the intention of his company to electrify its line between New York, Providence and Boston, as soon as the tunnel under the east side of New York City is finished.

THE TECHNICAL PUBLICITY ASSOCIATION devoted its meeting of December 20 to the subject of "The Value of Circulars and Printed Matter." Mr. Frank Vreeland, art editor of the *American Printer,* spoke of the commercial value of beauty in typography, and Walter Gilliss, president of the Gilliss Press, N. Y., made some remarks about limited editions. The session developed into an "experience meeting" and many of the members told of their methods and results with printed matter and circular letters. As usual at the monthly meetings, several new members were elected.

A TELEPHONIC BEVERIDGE.—A special dispatch from Chicago of December 27 says: "Senator Beveridge was scheduled to make a speech in Indianapolis to-night at the dinner of that city's medical society. He was to discuss 'The Nation's Peril.' When the Senator got ready to leave Chicago to keep his engagement he discovered that the train he had intended to take to Indianapolis was late. It was impossible for him to reach that city in time for the banquet. He solved the problem by getting into long-distance telephone communication with the banquet hall and dictating his speech, which was repeated to the diners." The auditors now know that the peril of the nation is not long-distance intoxication.

ELECTRIC TALKS IN ROANOKE.—The Roanoke Railway & Electric Company has recently been giving an excellent series of "Electricity Talks" in the local daily papers of that progressive Virginia city. They are signed by Mr. J. W. Hancock, the general manager, and were prepared under his instructions by the C. W. Lee Company, of Newark, N. J., with wonted skill and shrewdness. They are clean-cut, straightforward statements as to the company's lighting and traction business, its improvements, its plans, its service to the public, its relations to the city, its plant, its park, etc. One of the most forcible points made is in the talk bringing out the fact that in the last six years the improvements authorized by the company for its system are $68,775 more than the $400,000 authorized by the city for itself.

ITALIAN TELEPHONE SERVICE.—With regard to the reports referred to in our issue of November 17, reflecting on the quality of the telephone service, the Societa Generale Italiana di Telefoni et Applicazioni Elettriche, of Rome, disputes the statement and says: "To prove that such an affirmation is thoroughly unfounded and absurd, we will simply inform you that the International Jury at the recent exhibition in Milan has awarded to our company the sole high prize for telephone systems, owing to the satisfactory technical and administrative organization of our concern. Other reasons than those referred to have induced our government to study whether or not it may be to its advantage to overhaul the service."

SCIENTIFIC BUSTS.—Mr. Morris K. Jesup has presented to the American Museum of Natural History in New York City ten busts of distinguished scientists, namely Franklin, Humboldt, Audubon, Torrey, Henry, Agassiz, Dana, Leidy, Baird and Cope. The ceremony of presentation took place on December 29. The busts are in white marble and are the work of William Cowper. Major Körner, who participated in the exercises, explained that he represented Baron Speck von Sternberg, the German Ambassador, who was unable to be present. In speaking on Franklin, Dr. Mitchell declared that he believed that political demands at the time that Franklin lived had taken much from the realm of science, using as they did so much of Franklin's time. Both Franklin and Henry are out of place, however, in the Museum of Natural History. They ought to be in the new building of the United Engineering Societies.

CENTRAL STATION PRICE LISTS.—The Edison Electric Illuminating Company, of Boston, has prepared and issued two excellent "price lists" of charges for service. One is devoted to the commercial sale of electrical energy and the other to municipal lighting. Each contains an enumeration of the schedules that apply, and then a careful explanation follows of the various schedules. The general terms and conditions are then set forth at the end. A careful explanation is also given of the "demand" system and the customer, whether private or public, is enabled from the documents to understand clearly and definitely the problem with which he is dealing. These price lists are the plan of campaign of the canvasser, half or more of whose work is done in advance by them for him, and they might be adopted or copied to advantage in other places.

THE NIAGARA DISPUTE.—It is stated from Washington that Secretary Taft is preparing to take up for final disposition the complex questions presented to him under the terms of the Burton act relative to the conservation of the waters of the Niagara River. Grave constitutional questions are involved. Representatives of the electric lighting and power companies which have been taking the waters from the river are insistent that the National Government has no authority to undertake to regulate the disposition of the waters of streams, save where the navigation thereof is concerned. In the case of the Niagara River, where the water is taken from the stream above the falls, only to be returned to it again below, this issue is not involved. So far, however, the right of the United States Government to regulate the admission of electric energy generated on the Canadian side of the river has not been challenged, and to this question the Secretary intends to first address himself.

MORE SUBWAYS to connect sections of Greater New York are proposed. At a meeting of the New York Rapid Transit Commission last week Mr. John B. McDonald, the contractor, submitted a plan for the construction of a subway bridge loop, leaving the old Brooklyn Bridge out of consideration, and connecting instead the Manhattan and Williamsburg spans over the East River. Mr. McDonald's plan includes a spur extending south from the loop to the intersection of Broad and Pearl Streets, thus affording connection between the Wall Street section and the residence districts of Brooklyn. The cost of the proposed belt line designed to feed the various systems was estimated at $10,000,000 without equipment. Chief Engineer Rice is to examine and report. Mr. McDonald declared that a belt line such as he proposed, connecting the Manhattan and Williamsburg Bridges, and leaving the Brooklyn Bridge free, was much needed. He said it should be remembered in that connection that the tunnel under the East River from the Battery would afford only two tracks, and that the utmost capacity of a two-track road was 20,000 persons an hour. "I have made a careful, somewhat lengthy, study of the situation," he said, "and I have concluded that the road as outlined by me in my plan will prove a sure and efficacious remedy for relieving the congestion at the terminal of the Brooklyn Bridge. At the same time it will obtain a proper distribution of the traveling public all over the Manhattan downtown business section, instead of turning all the passengers out at a given point, as now. The plan will afford accommodations far superior to any now in use, to a population exceeding 350,000, or more than one-third the entire population of the Borough of Brooklyn. As contemplated, the road will be about eight miles long, and it will have seventeen stations."

ENGINEERING PATENTS LIBRARY.—The trustees of the Engineering Societies Building has appointed Mr. W. D. Weaver a committee of one to make inquiry and report on the subject of a complete collection of United States engineering patent specifications, classified and bound by subjects, for the library of the new Engineering Societies Building. The collection would comprise about 200,000 patents, and receive about 8,000 accessions annually.

INDIANA ENGINEERING SOCIETY.—This body will hold a convention January 17, 18 and 19 in Indianapolis. The programme includes the following among the papers: "Interurban Railway Engineering," by R. P. Woods, chief engineer Indianapolis & Western Road; "Advantages of Electrical Inspection," by F. R. Daniel, chief State Inspector for the insurance organizations; "Electric Car Braking," by H. T. Plumb, Purdue University; "Principles of the Telephone," by Prof. Arthur Berry Smith, Purdue University; Prof. W. F. M. Goss, Purdue University, promises a paper. The secretary is Mr. C. C. Brown, 408 Commercial Club Building, Indianapolis.

COMMITTEE OF SAFETY.—The Automobile Club of America has taken steps to organize a committee of public safety, consisting of its ex-presidents, now four in number, to sit virtually in permanence, in order to consider and secure the adoption of ways and means for correcting evils associated with the growth of automobilism. An excellent preliminary report has been prepared and circulated. One of the recommendations, we note, is that automobilists do not use acetylene lamps in city streets. Another is that chauffeurs of club members should all undergo a technical examination as to ability. A third is that all A. C. A. automobiles should carry a distinctive club designation in the shape of flag, banner, tablet or insignia.

TRAIN TELEPHONY has been revived in the invention described in the following telegram from Louisville, Ky., of December 21: "A successful test of a device for telephoning from moving trains was made this afternoon from a train going at 20 miles an hour on the Worthington-Carrollton line of the Louisville & Nashville, about 60 miles east of here. Messages were sent to this city and to other cities over the long-distance lines from here with unusual distinctness. Connection was made through this city with the Associated Press offices in New York City, but the conversation to that point was not a success. The apparatus used is the invention of Mr. A. D. Jones, of this city. The telephone on the train was connected with a trolley arrangement on the pilot of the engine from which, by means of a stream of chemicalized steam, the circuit was completed with two wires stretched alongside the track."

"GOING IT BLIND."—At the Chicago charter convention meeting recently it was voted to incorporate in the new charter draft provision for municipal ownership, through Mueller law certificates, of every public utility in Chicago, either above or beneath the surface. Within thirty minutes, at the end of the session, the entire chapter on utilities, with the exception of the frontage provision, was put through the convention. The chapter on public utilities as recommended by the convention follows: "The provisions of the Mueller law and the limitations contained therein (including the 20-year limit on franchises), except as herein otherwise provided, shall be extended to all intramural railways, subways, telephone, telegraph, gas, electric lighting and power plants, and other local public utility works operated in, over, under or upon the streets and public places of the city, also to docks, wharves and their necessary appurtenances.

PARIS TELEPHONE GIRLS are beginning to enjoy the care and comforts long afforded to their sisters in America by the private corporations. But even in France this philanthropic work is not being done by the Government. An extremely comfortable and moderately-priced hotel for the use of telephone girls was recently opened in Paris. It is a fine building six stories high situated on the Rue de Lille. This new hotel for working girls is not a commercial venture, but has been built by a body of philanthropists which includes some of the best known names in France. There are 120 pretty bedrooms in the building, all well lighted and ventilated, and they are let at moderate rentals varying from 18 to 30 francs a month. The hotel contains spacious dining saloons, reading rooms and halls, all lighted by electricity and heated by steam. The large bright restaurant is most inviting and comfortable, and a really good meal can be obtained for less than a franc. The accommodations for only 120 bedrooms seem to leave the supply rather inadequate.

SOUTHERN APPALACHIAN RESERVES.—Prof. C. H. Porter, of the Massachusetts Institute of Technology, writes us in regard to the important measure before Congress, known as House Bill No. 13, which provides for a federal forest reserve in the Southern Appalachians and in the White Mountains. He emphasizes the value of such reserves and makes the following plea: "These reserves can be formed only through the action of the central Government as the streams rise in the mountain forests of some of the States, while the important water powers thereon are located in other States. This is true of no other part of this country which is not already provided with forest reserves. Almost every one connected with the electrical industry, whether in the manufacturing or operating end, is more or less directly interested in the preservation of the water powers of this country and many of the water powers in the southern Appalachian region are so located that they can be utilized commercially only through electric transmission. In view, then, of this lack of appreciation on the part of some of our law makers and of the very great importance of the general principles involved it seems to me that every reader of the Electrical World should exercise his best influence in behalf of the bill and this may best be done by writing a letter to his representative in the House. The interest which is manifested simply by passive approval never secures results. Are not these forest reserves worth at least a letter?"

PASSES FOR TELEGRAPHERS.—The Interstate Commerce Commission has announced its decision on the petition of the Western Union and Postal Telegraph Companies for a modification of the rulings of the commission in regard to what shall constitute payment for transportation and to the issuance of free passes, so far as such rulings might control or govern certain contracts entered into between the telegraph and railroad companies. Its decision upon the railroad and telegraph company contracts is in substance as follows: As a telegraph service along its right of way is essential to the safe operation of its trains, a railroad company or a group of separately incorporated roads generally recognized as a "railway system" may lawfully contract to furnish free or reduced rate transportation to a telegraph company for such of its officers, men, materials and supplies as are required in connection with the construction, maintenance and operation of such a telegraph line and service upon its own right of way; and the legality of such free or reduced rate transportation is not affected by the fact that the telegraph company may also use such telegraph line in connection with its telegraph service to the public. But such a railroad company or system of roads cannot lawfully contract, in consideration of free telegraph service or service at reduced rates over wires beyond its own right of way, to furnish free or reduced rate transportation for the officials, employes, laborers, materials or supplies of a telegraph company in connection with the construction, maintenance or operation of a telegraph line and service off the line of such railroad company or system of railroads and upon the line or lines of other carrier or system.

Power Stations of the Citizens Light, Heat and Power Company of Johnstown, Pa.

THE Citizens Light, Heat and Power Company, of Johnstown, Pa., was incorporated on August 12, 1902, and absorbed the Johnstown Light, Heat & Power Company and the old Citizens' Light, Heat and Power Company. The company supplies electricity and steam heat to Johnstown, a city having a population of about 70,000. Two stations are in operation; one on Vine Street and the other on Broad Street. The former is a direct-current station and supplies a 110-volt, three-wire system to the adjacent business and residential section of the city as well as exhaust steam for heating to a large area covering practically the entire business section. The Broad Street station, which has been in operation only a short while, is a turbine-driven station supplying a 4,000-volt, four-wire, three-phase system and is the source of alternating-current supply throughout the central and outlying districts.

The Vine Street station is in the heart of the commercial lighting and heating load. Steam is generated in four 250-hp and two 375-hp Heine water-tube boilers and two additional 375-hp units will shortly be installed. The furnaces of the boilers are fitted with Murphy stokers adapted for burning cheap fuel. The coal, which is run-of-mine costing about $1.25 per ton, is carted to the station on trucks, where it is dumped into a hopper and passes thence through a coal elevator and crusher to bins above the boiler. A Green economizer is used in connection with part of the plant. The feed water, which is purchased, but which may also be taken from a well, is passed through a Pittsburg feed-water heater and is delivered by pumps of Worthington make, to the boilers.

The steam piping system comprises two headers in the boiler room into which two mains from each pair of boilers deliver steam. Individual 12-in. mains in duplicate from these headers lead under the engine room floor and connections are made with the engines through goosenecks so as not to interfere with the operation of the overhead crane. The engine and generator equipment comprises one Ball & Wood 300-hp engine driving two 100-kw, 120-volt generators operated on a three-wire system; one 200-hp tandem-compound Buckeye engine belt-driving two 60-kw Edison bi-polar machines; one 300-hp tandem-compound Buckeye engine driving through a coupled shaft two 100-kw multipolar generators; one 300-hp tandem-compound Buckeye engine driving also through a shaft three No. 12 Brush arc machines; a twin Buckeye engine of 700-hp capacity direct-connected to two 200-kw, 125-volt direct-current generators; one 200-kw rotary-converter and one 400-kw motor-generator set. The rotary and the motor-generator set act as links between the two stations. Under normal conditions alternating-current is converted to augment the supply of direct-current from the Vine Street station. The rotary and motor-generator set are used mostly during the summer months when steam for heating is not required, so that a large portion of the direct-current equipment can be withdrawn from service. When the alternating-current load is light or during emergencies the rotary and motor-generator set are used to furnish the alternating-current supply.

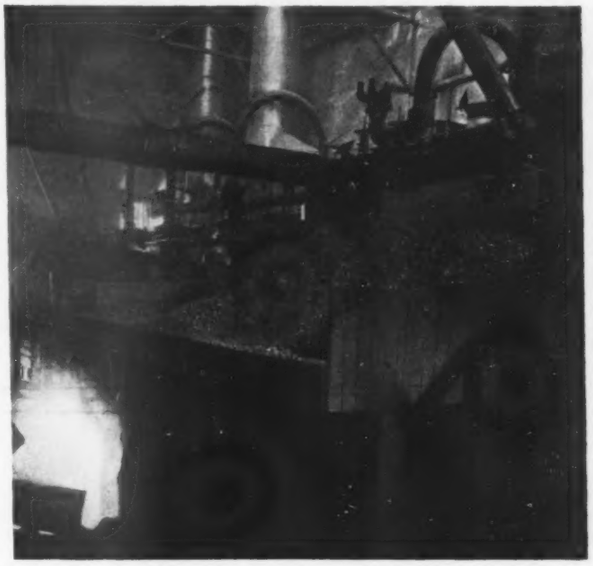


FIG. 2.—BOILER ROOM; VINE STREET STATION.

FIG. 1.—GENERAL VIEW OF INTERIOR; VINE STREET STATION OF CITIZENS LIGHT, HEAT AND POWER COMPANY.

Changes contemplated in the equipment at the Vine Street station will involve the scrapping of the Edison bi-polar machines and the substitution of motor drive for the arc light machines, or possibly mercury arc rectifiers instead of the arc machines. A new 1,000-kw direct-connected unit is also contemplated with a storage battery floating on the system to take the surplus energy during light load when the engines have to be kept running to supply the steam heat. It will be some time, however, before these changes are made.

Streets and adjoins the main line of the Pennsylvania Railroad, a spur track from which serves for the convenient supply of coal. The building is a steel and concrete structure 108 ft. long by 88 ft. wide and houses 800 kw in Westinghouse turbo-generators and 1,200 hp in water-tube boilers together with auxiliary machinery and switchboards. Space is available for an additional turbo-generator, the boilers for which form part of the original installation, and should this not be sufficient to meet the demand the building may be extended. The

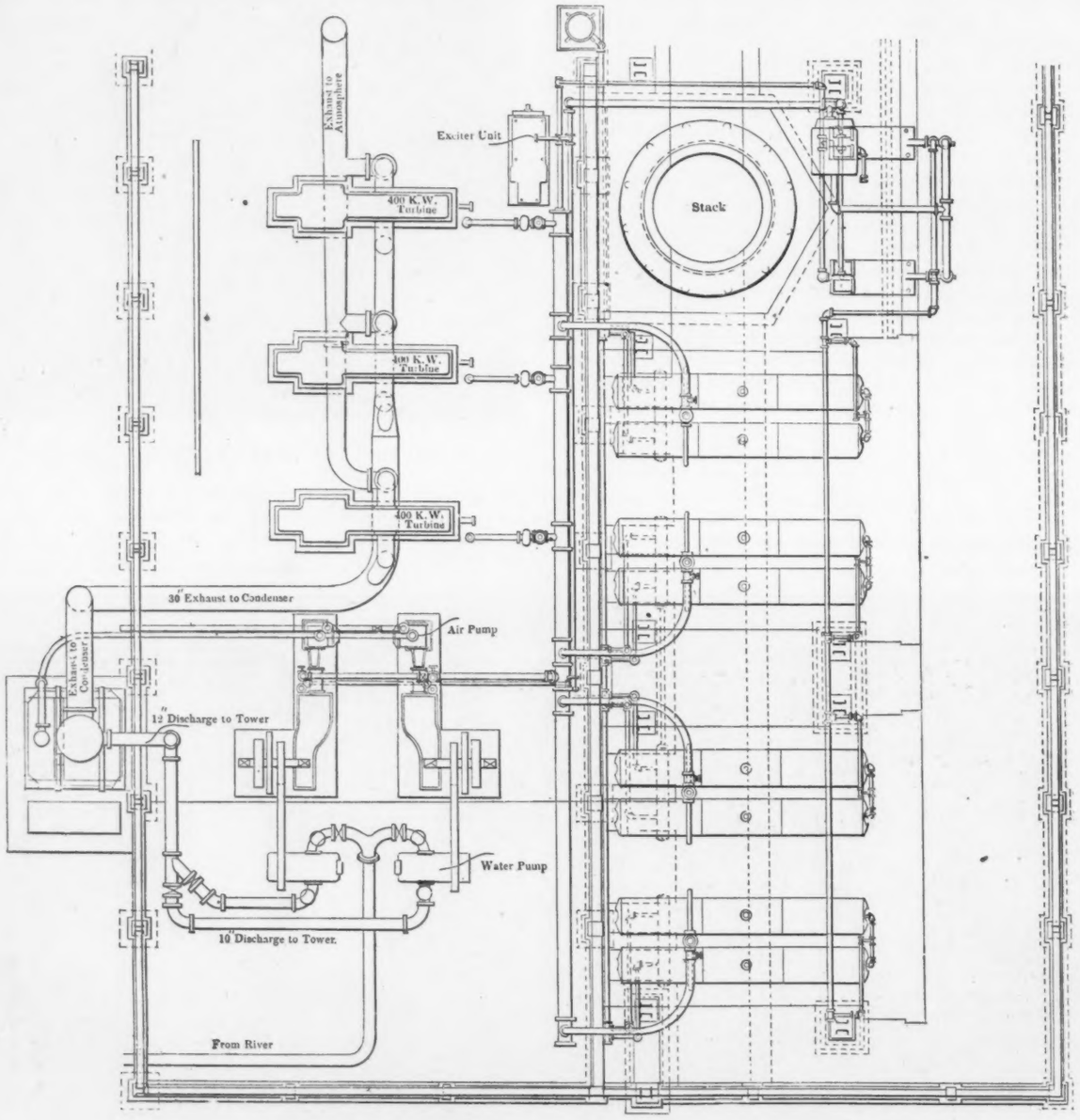


Fig. 3.—Plan View; Broad Street Station of Citizens Light, Heat and Power Company.

The switchboard is equipped with 15 panels, two of which are blank, and follows standard General Electric practice in design and in the instruments installed. All of the circuits are overhead and within a year it is expected to have the circuits all underground as are the telephone circuits in Johnstown now.

The Broad Street station, which is modern in every respect, operates only at night, and during the summer months it is used to carry the day load also because of its more efficient operation when steam heating is eliminated from consideration. The power house is located at Broad and Tenth

chimney now in use is large enough for a boiler plant of twice the present size.

A brick partition devides the boiler and generator rooms, and monitors in the roof of the boiler room and in the roof of the generator room, besides affording abundant light and ventilation in both rooms, serve also for carrying the feed wires to the pole line in the latter room and for the horizontal run of the coal conveyor system in the former room. Basements are provided under both rooms; that under the boiler room is utilized by ash cars, while the basement under the engine room contains the steam, exhaust, atmosphere and

auxiliary piping. The lay-out of the equipment is shown in the accompanying plan view of the station.

A feature in the design of the steam equipment is its compactness. The boilers are supplied with fuel automatically and the flue instead of being in the rear or above the boilers is beneath them. The boilers are thus enabled to be placed against the partition wall, ample access to the rear being provided by doors in the sidewalls of the setting. The steam header is located in the basement of the dynamo room. The boilers, which are of 300-hp rated capacity each, are of Babcock & Wilcox make. They are arranged in batteries and are suspended from steel girders resting upon latticed columns placed outside the setting so as to be free from stresses. Each safety valve discharges through a pipe passing through the roof so that the boiler room is kept free from escaping steam.

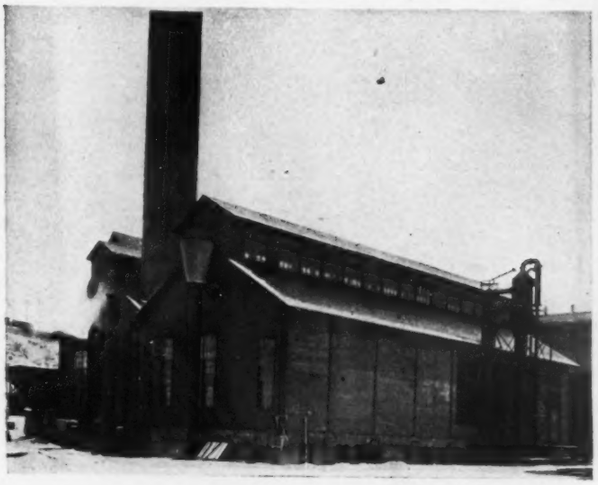


FIG. 4.—EXTERIOR OF BROAD STREET STATION, SHOWING CONDENSER.

Large combustion chambers are provided in the boiler setting and these are fitted with Murphy automatic inclined-grate stokers for burning run-of-mine coal from the mines near by. The coal gravitates from overhead bunkers through chutes and the ashes gravitate similarly to cars in the tunnel beneath the boiler room. The coal as received from the railroad cars is first crushed and then elevated to a scraper conveyor extending over the bins. Slides are provided at frequent intervals to secure proper distribution of the fuel in the bins. The coal-handling apparatus was supplied by the Link Belt Engineering Company and is driven by three-phase induction motors. The crusher is operated by a 20-hp motor, the elevator is operated by a 10-hp motor and the conveyor is operated by a motor of similar size

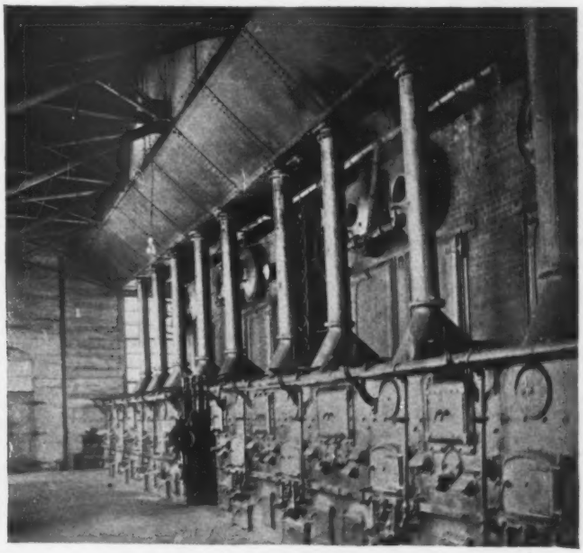


FIG. 6.—BOILER ROOM, BROAD STREET STATION.

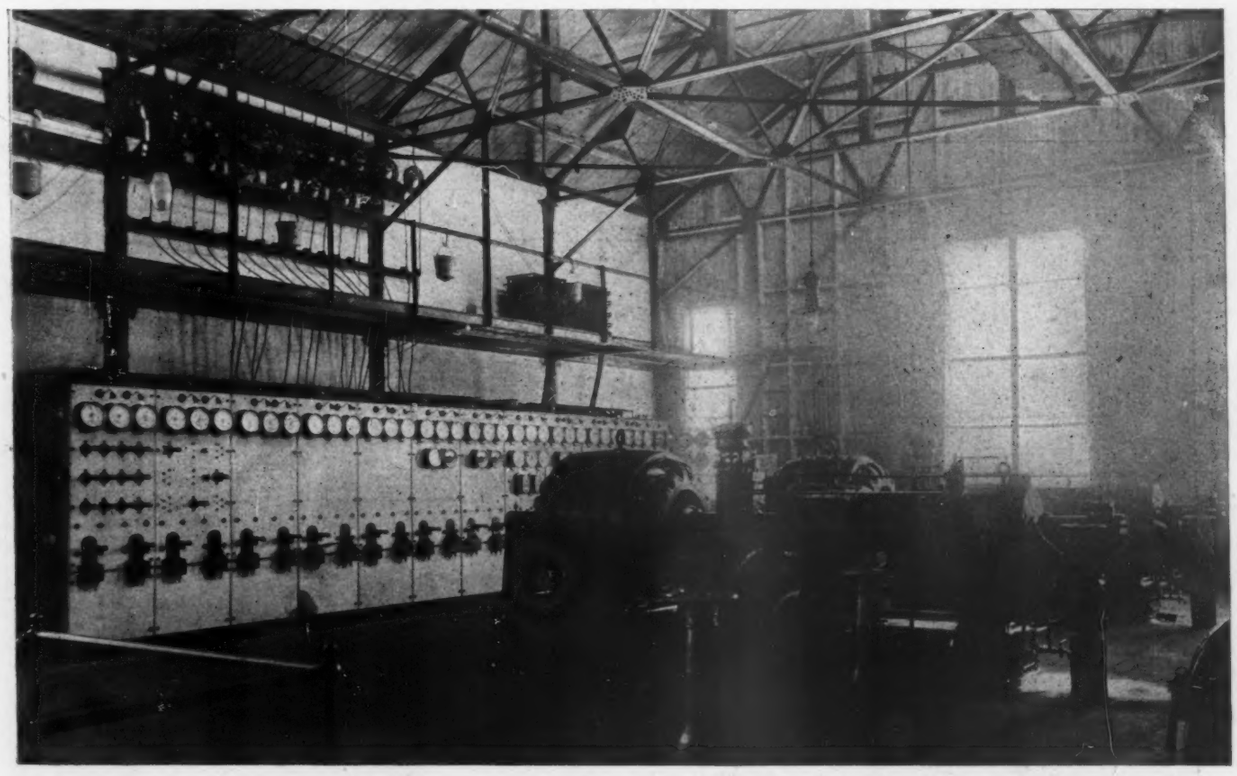


FIG. 5.—GENERAL VIEW OF INTERIOR, BROAD STREET STATION OF THE CITIZENS LIGHT, HEAT & POWER COMPANY.

to that operating the elevator. The installation is capable of crushing, elevating and storing 30 tons of run-of-mine coal per hour. The storage capacity provided is 200 tons.

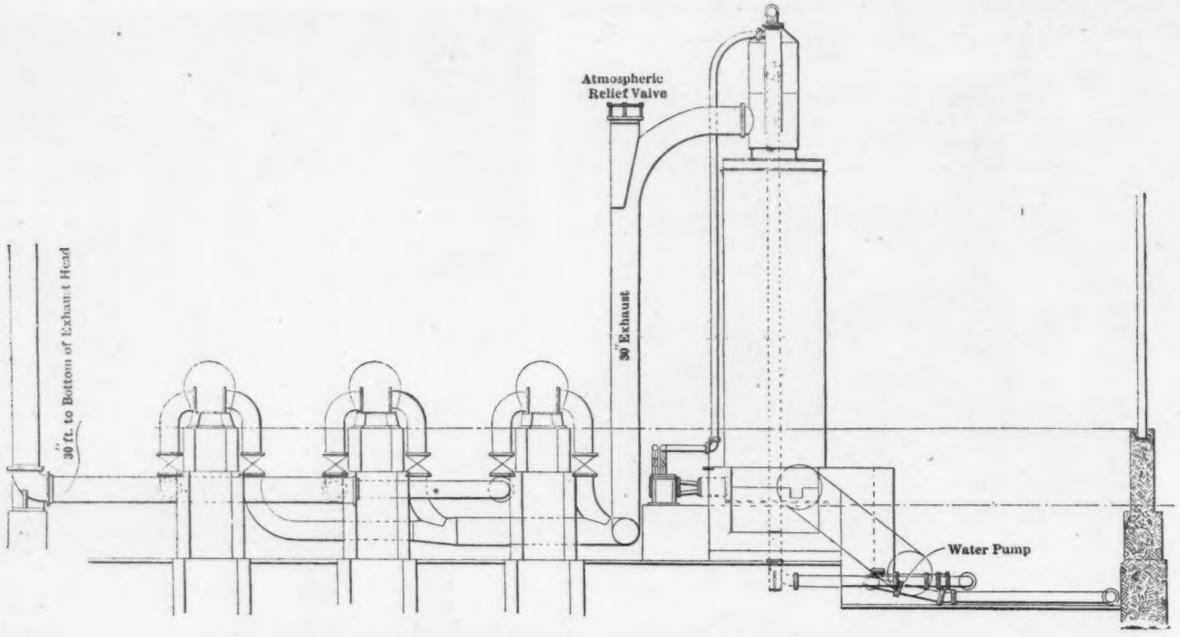


Fig. 7.—Elevation of Exhaust Piping; Broad Street Station.

The boilers are provided with coil superheaters, which supply steam with a moderate degree of superheat. The high-pressure steam piping is supported on flexible iron hangers and is anchored at the center of the header. Long radius bends provide for expansion and the header forms the lowest part of the live steam system. Drips are provided at intervals to receive the water of condensation and these are controlled by Bundy steam traps, which also drain the separators protecting each turbine. The pipe fittings are extra heavy and corrugated copper gaskets sealed with rubber are employed. The live steam piping is lagged with 1½-in. magnesia covering. The auxiliaries receive steam from the main header or a 4-in. extension, as no auxiliary header is provided. The pumps operate under full boiler pressure; but the steam-driven exciter is fed with steam through a reducing valve.

The boilers are fed by a duplicate set of Epping-Carpenter plunger steam pumps, whose suction is connected to a Cochrane open feed-water heater receiving exhaust steam from the auxiliaries. Each mud drum is connected to a 4-in. blow-off main, which discharges into a 30-in. standpipe acting both as a muffler and as a condenser.

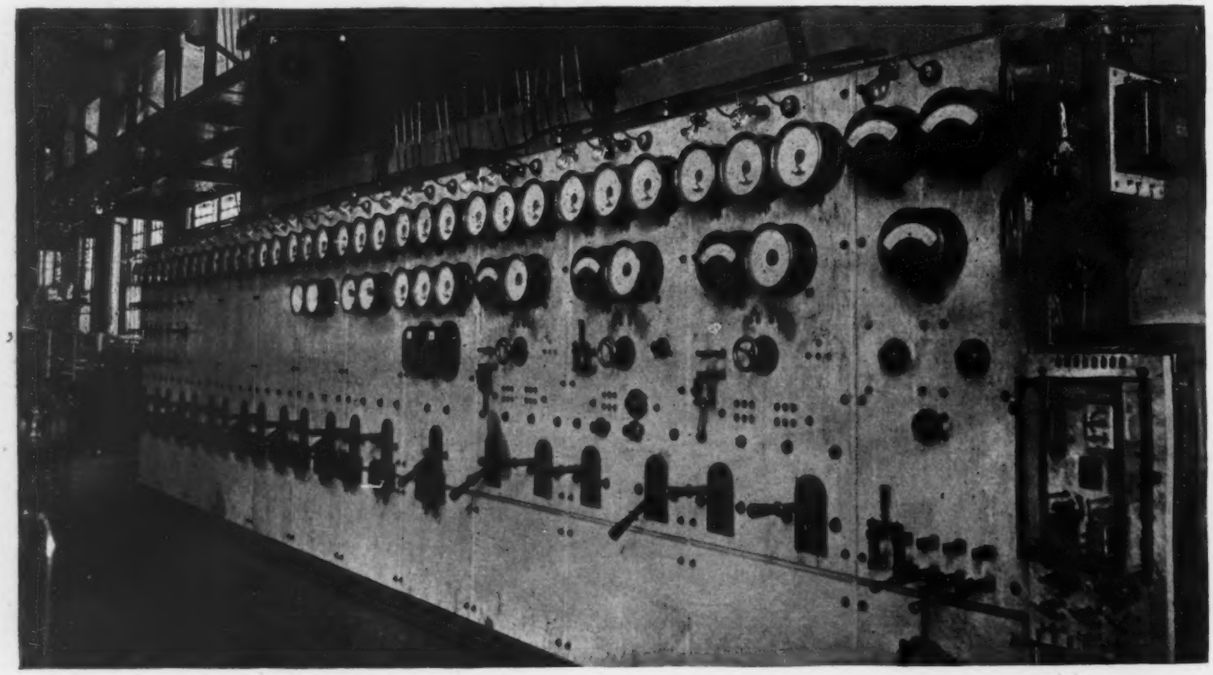


Fig. 8.—Switchboard; Broad Street Station of the Citizens Light, Heat and Power Company.

Two turbines each of 400 kw capacity are at present installed. Steam is supplied to them from a 14-in. main beneath the floor and the turbines discharge their exhaust through 20-in., 90° bends into the exhaust line in the basement, each discharge being controlled by a 20-in. outside screw and yoke valve provided with miter gearing for operation from pedestals in the floor above. Corrugated copper expansion sections are inserted

FIG. 9.—TWIN DIRECT-CURRENT UNITS; VINE STREET STATION.

in the line to relieve stresses of expansion and contraction. A separate atmospheric exhaust connects through valves from the other side, as shown in Fig. 7.

The turbine equipment is standard throughout. Each turbine is controlled by a fly-ball governor provided with special adjustments for paralleling the alternators. The speed of the turbines is 3,600 r.p.m. The main bearings are continuously supplied with oil under pressure, which is kept circulating by a single-cylinder pump driven direct from a reciprocating arm geared to the shaft through a worm. Whatever heat is generated is removed from the oil by passing it through a pipe coil cooler located in the bed plate of the turbine. The supply of feed water for the boilers is drawn through the cooling coils of the turbines, thereby reclaiming the cooling water, which would otherwise constitute a waste unless used for some other purpose. The turbines are equipped with secondary valves, which admit high-pressure steam into an intermediate stage of the turbine. The valves are arranged for manual operation and enable the turbines to sustain overloads of 50 per cent when operating condensing or full load when running non-condensing. The turbines are designed to operate on a steam pressure of 160 lb. and with a vacuum of 27 in.

FIG. 10.—MOTOR-GENERATOR AND ROTARY-CONVERTER SETS; VINE STREET STATION.

The generators, which are driven through flexible couplings, are of the separately-excited, revolving-field type. Exciter sets in duplicate are provided each of 25 kw capacity. One is a direct-connected engine-driven set and the other is driven by a 40-hp induction motor. With steady loads the motor-generator set is used and with violently fluctuating loads the engine-driven set is used for obvious reasons.

The condenser is of the barometric type and was built by the Southwark Foundry & Machine Company. Boiler feed water is supplied from the city mains, but water for condensing purposes is taken from the Conemaugh River some distance away. This water is unsuitable for boiler feed purposes and also for surface condensers because of the fact that the large mills of the Cambria Steel Company are located on the banks of the river at Johnstown, and not only are the waters of the river polluted by this means, but oftentimes heated as well. The condenser is located outside the power house and is supported on a trussed steel tower resting on a brick foundation forming the hot well. The auxiliary apparatus is in duplicate. The air pumps are coupled tandem to a horizontal single-cylinder engine which also drives through belting a rotary water pump delivering cooling water to the condenser. The speed of the engine is controlled by a throttle governor equipped with a friction speed change device. The rotary pumps are located in a pit in the basement somewhat lower than the other apparatus so as to reduce the suction lift from the river which at low water is about 10 ft. The pump draws water through 740 ft. of 14-in. main and discharges directly into the condenser through a 12-in.

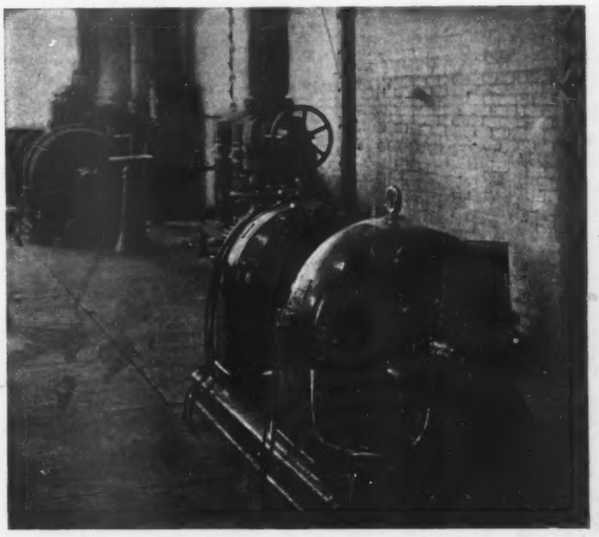


FIG. 11.—EXCITER UNITS; BROAD STREET STATION.

riser. The condenser is guaranteed to handle 400 lb. of steam per minute with injection water at 70° F. and to maintain a vacuum of 27 in., requiring under these conditions about 24 lb. of water per pound of steam condensed.

The condenser and the exhaust piping are built of riveted sheet steel, caulked under vacuum. Plain rubber gaskets are used with riveted flanges and the ends of the pipes peened over. At the top of the exhaust riser is a balanced atmospheric relief valve set to open at a few pounds pressure. All the exhaust piping is provided with long radius bends in an attempt to eliminate as far as possible the loss of vacuum between the turbines and the condenser because of friction and eddies in the somewhat circuitous path of the exhaust steam.

The distribution system from the Broad Street station is carried out with a four-wire Y-connected system with 4,000 volts between outers and 2,300 volts between neutrals and outers. The four wires are carried directly from the station to supply heavy load centers and power circuits. Single-phase circuits are supplied directly from the switchboard, which is arranged so that the load may be shifted from one phase to another so as to keep the system balanced. The switchboard is made up of 12 panels of blue Vermont marble and with the instruments was installed by the Westinghouse Electric & Manufacturing Company. The bus-bars are in duplicate and round dial, long-scale

instruments are used. The circuits are completed through four-pole, double-throw oil switches, which are provided with circuit-breaker attachments on the distribution panels. The output is recorded on polyphase watt-hour meters.

The shifting of single-phase circuits to balance the load is accomplished with insulated plugs, an interlocking device preventing short-circuit by insertion in the wrong socket. The arc panel is also equipped with plug sockets. The alternating-current series arc light system is supplied from General Electric tub transformers, but the direct-current enclosed arc lamps are supplied from the Vine Street station. All outgoing leads are protected by choke coils with lightning arresters in series to ground. The feeders after leaving the station are carried on latticed poles along Broad Street to the junction with the main line.

About one-third of the connected load is supplied with alternating current while the other two-thirds of the load is supplied with direct current. The price of electrical energy ranges from 9 to 2 cents per kw-hour, while gas at Johnstown sells at one dollar per thousand cubic feet for fuel purposes and $1.20 per thousand cubic feet for illumination. The Holly system of underground exhaust steam distribution, installed by the American District Steam Company, of Lockport, N. Y., is in use at the Vine Street station, and the income from this is in round numbers $26,000 per year. The company's mains are located in the

FIG. 12.—CORNER OF SUPPLY ROOM; VINE STREET STATION.

central part of the city and radiate about 3,000 ft. in all directions. The engines operate with a back pressure of from 2 to 5 lb., depending on conditions, and in winter the exhaust is supplemented with live steam. The heating season at Johnstown extends from the first of September to the first of June. The rates average from 40 cents for the first 10,000 lb. of water condensed to 15 cents where the condensation measures over 100,000 lb. The pipes are buried from 3 to 6 ft. below the surface and are insulated with sheet asbestos and enclosed in tin-lined wood casing with an air space between the tin and asbestos. All steam is supplied by meter which measures the condensation, and owing to the unevenness of the city this water is allowed to run off in the sewers. If the system were being laid out again the water would be pumped back to the station and used over again, but the conditions do not justify the installation of return pipes at this time.

The company has a connected load of about 700 enclosed arc lamps, 55,000 incandescent lamps and 1,000 hp in motors. Both three-wire direct and alternating-current day circuits are maintained and a 230-volt motor circuit. The city contracts for 400 arc lamps at a rate of $40 per year. Commercial arcs of 1,200 nominal candle-power are rated at $60 per year. A portion of the Vine Street station is occupied by a fully-equipped and well-stocked storeroom where electrical supplies are on sale. The company does construction work, sells motors and installs any kind of electrical apparatus. No solicitors are employed, but circulars are sent out with bills and bulletins from one of the advertising companies are also mailed at intervals. Much of the literature is supplied by the manufacturers of apparatus. Over 200 electric flatirons were sold by the company this summer and quite a number of electric signs were installed. Incandescent lamps are renewed at the rate of 15 cents each. All customers are served through meters. The office of the company is situated in the Vine Street station, and the officers are Charles S. Price, president; James G. Ellis, vice-president, and Curtis G. Campbell, secretary and treasurer. J. W. Reeves is the general manager of the company, to whom we are indebted for the information contained in this article, and August Weis is the superintendent.

Alcohol Engines as a Future Power.

By Elihu Thomson.

THE internal combustion engine has undergone a great development in the past ten or fifteen years. Where formerly the Otto cycle or four-cycle type, as it is now called, with hit or miss governing was general, we now have variations in the method of governing of the four-cycle engines, and the modification known as the two-cycle engine, which has also received a considerable amount of attention. Formerly these engines, generally used with combustible gas, were constructed to be run at a steady speed with a more or less definite duty. In such cases the speed was maintained by a governor which was in many cases made to cut off the fuel charges abruptly so that the engine would fail to make an active or explosive stroke, or fail to make several explosion strokes at intervals, the active strokes coming in between and maintaining the speed of the engine at the normal; a heavy fly-wheel being a necessity of the case.

The Priestman oil engine, which began to be introduced some fifteen years ago, did not employ the hit or miss principle, but the charges were variably throttled by the governor so that each stroke was an active stroke; but the force of the explosion underwent great variation due to the differences of compression of the fuel charge and air. It is interesting to note that this method of operating engines is not only employed largely in gas engines to-day, but is also used in automobile engines using gasoline where the duty is widely varied and where the speed is also subject to great variations. The Priestman oil engine employed the heavier oils, such as kerosene. The oil was put under a head of a few pounds and entered a heated vaporizer under control of a small conical valve actuated by the governor, which vaporizer was kept hot by the exhaust gases circulating around it. Through this same vaporizer the inflow of air took place and picked up the oil vapor which was drawn through an automatic valve during the intake stroke. Thus the warmed air carrying vaporized oil entered the cylinder at atmospheric pressure when the engine was doing full duty, or at a less pressure when the engine was carrying only a partial load. The return or compression stroke of the piston brought the mixture of oil, vapor and air to a pressure of some 20 pounds or more, and it was fired by electric ignition of the jump spark variety. The compression was necessarily low, as the charge having been preheated in the vaporizer would have been subject to the evil of pre-ignition had the compression been much increased. The economy of the engine was fair under full load, but under low loads the action was as if the fuel were burned to chase the piston.

In this case of burning under practically no compression the explosion stroke was not made efficiently. In the ordinary gasoline engine of to-day, such as is employed in automobile service, there is no definite speed governing, and the charge is introduced into the engine by suction of air, which carries with it gasoline spray and vapor. The vaporizer depends for its action on the suction of the intake stroke. In some forms of gas and oil engines the fuel charge is definitely fed by a fuel pump, and with the hit or miss type of governing the pump charge is defi-

nitely set to an amount which will just produce the proper combustible mixture with the volume of air taken in at each intake stroke. In other cases the effective stroke of the fuel supply pump has been varied with variations in amount of air indrawn, but this becomes a very difficult matter in the case where the engine is driven under considerable variations of speed. For this reason, the internal combustion engine, either of the four-cycle or two-cycle type, as employed in automobile and similar service, which may demand wide variations of speed and power, now generally employs a throttled intake and a vaporizer supplying the fuel charge to the air just before it enters the inlet valve or passage. In the two-cycle engine the mixture is generally made before it enters the crank case, from which it is expelled in the scavenging stroke to drive out the exhaust gases and take their place within the cylinder, ready for compression and explosion.

With gasoline as a fuel, which vaporizes at ordinary atmospheric temperatures, warming of the vaporizer or the entering air has been resorted to only in special cases, but the difficulty of obtaining grades of gasoline of the lowest boiling points together with the variation in effect when the outside temperature is low is tending to compel attention to the need of a warmed vaporizer. This is all the more so when engines of enlarged capacity are used. If the fuel in the vaporizer is of higher boiling point, the vaporization is then rendered effective by simply raising the temperature of the vaporizer, or raising the temperature of the fuel as it enters the air with which it is mixed; or while raising the temperature of the fuel also raising the temperature of the air somewhat so that it may the more easily take up and carry the vapor of the less volatile fuel.

In the case of denatured alcohol, which it is hoped may become available at a reasonable price before long, the same form of vaporizer as that used with gasoline will satisfy the conditions, except that it will receive a preliminary heating so as to confer upon the alcohol vapor the same degree of volatility as is possessed by gasoline at ordinary temperatures. In the same way, by raising the temperature of the vaporizer still more, it is quite possible to use liquid fuel of much higher boiling point, and even kerosene oil. The writer has, in fact, repeatedly run an engine with the vaporizer arranged to have its temperature controlled, and employed gasoline, alcohol and kerosene oil interchangeably. An engine starting cold with an arrangement for allowing the exhaust gases to heat the vaporizer may burn a small amount of gasoline at the start, and on the attainment of a temperature sufficient to vaporize alcohol, the alcohol may be gradually turned into the vaporizer, and if the arrangement is such as to still further increase the temperature of the vaporizer, kerosene oil may finally replace the alcohol. But it is hoped that it will not be necessary to go so far.

It will doubtless take considerable time, possibly two, three or more years, before the arrangement or organization for the production and distribution of the denatured spirit is sufficiently perfected to give us the product at a price which will compete with that of gasoline in the denser populated districts where the methods of distribution of the oil products are already in a high state of development. In the more sparsely populated districts, however, where, on account of the distances for distribution and inconvenience of storage gasoline now commands an advanced price, it should not be long before denatured spirit should be able to compete. It is fortunate that in spite of the considerably less heat value possessed by alcohol, as compared with any of the oil products such as gasoline, the efficiency of the engine may be increased in the case of the alcohol by increasing the compression so as to make up the difference. The limit of compression in the ordinary type of engine is naturally dependent upon the pre-ignition point of the charge during compression, and inasmuch as there is always a certain amount of the prior heated exhaust gas mixed with the new charge, while the cylinder walls are also necessarily at a considerably higher temperature than is the water in the jacketing, or than is the radiating metal where air cooling is employed, it is obvious that pre-ignition, when the heavier vapors are employed, must be regarded as setting the limit of compression which is feasible. Upon this degree of compression, however, the efficiency of the engine in large measure depends. With the employment of alcohol the compression may be so raised that two things are accomplished: first, there is a greater extraction of energy on expansion, resulting in a cooler exhaust; second, the cooler gas which remains in the cylinder and is mixed with the new charge results in further rendering pre-ignition improbable. It is true also that such a mixture would stand higher temperature of the walls of the combustion space without pre-igniting; consequently an alcohol engine can be run with the water boiling vigorously in its water jacket, a condition which almost invariably leads to pre-ignition difficulties with oil engines or gasoline engines unless the compression be kept quite low. It was noted in the Banki experiments that with oil engines the introduction of a certain amount of water in the form of steam or spray along with the fuel charge increased the efficiency of the engine. The commercial alcohol in any case will contain from 5 per cent to 10 per cent of water, and in the writer's experiments there was a tolerance of 15 per cent to 20 per cent; or in other words, about 80 per cent alcohol could be used. Below that point the ignition became somewhat irregular.

There is no need to dwell here upon the superior safety of alcohol owing to its higher boiling point and its condition of being perfectly miscible with water in all proportions. It is probable that the first development in the use of alcohol as a fuel for internal combustion engines will take place in farming districts or remote districts where gasoline itself is very high in price. It is also probable that at first the engines may be used with mixtures of alcohol and gasoline in varying percentages with a gradual increase in the percentage of alcohol as its price goes down and the price of gasoline rises. In this way a gradual adaptation of the conditions may take place and the present production of gasoline be spread over a fuel consumption of very much larger amount. The introduction of alcohol may, therefore, be said to practically make it possible to extend the use of gasoline. There is, of course, at present a field for the application of alcohol engines in such places as Cuba, which already possesses cheap alcohol fuel, these engines often being employed for driving dynamos for lighting or power transmission upon plantations or upon country estates, and it can confidently be expected that as soon as the conditions are such that the price of alcohol in the United States is brought down to a figure as low as that of gasoline in any section, a great opening for the use of alcohol engines will be made. It would certainly seem to be an ideal engine for use in agricultural districts for farm machinery and the like. It is quite probable that in districts where even water for cooling is scarce, air cooling may be resorted to with perfect success. At the same time alcohol would relieve boat propulsion by the internal combustion engine of a considerable proportion of its recognized dangers when gasoline or highly volatile hydrocarbons are used.

As a fuel for the operation of small or moderate capacity isolated plants, alcohol will undoubtedly find extended application. As such plants will run for a number of hours at least, after starting, the question of preliminary heating of the vaporizer will not constitute a disadvantage of any moment. The preheating can be accomplished in a minute or two without any risk by separately heating a mass of metal (as by an alcohol torch) and placing it in contact with the metal of the vaporizer itself, and the heated metal piece may be made to jacket or closely surround the vaporizer with considerable surface in contact with the same and if needed its outer exposed surface be covered, permanently or temporarily, by a non-conductor of heat such as asbestos. Electric ignition of the make-and-break type or of the usual jump spark type may, as with gasoline, be applied. There would be no possibility of interruption due to freezing, as is the case when gasoline carries a little water, which later congeals in the passages. Moreover, since the alcohol engine can be used with the jacket water at boiling temperatures, the heat of the jacket, supplemented as it can be by the exhaust gases applied to further heat or to boil water or vapor, may be used in winter for steam heating or hot water

heating either alone or in conjunction with existing plants for that purpose. There is no need to dwell upon these possibilities, all so conducive to economy of application of the fuel.

In the foregoing attention has been briefly called to the peculiar fitness of alcohol for power purposes, the properties of which, together with the conditions of use, are alike favorable to its employment. It has sometimes been objected that the products of its partial combustion or oxidation are likely to be acid and corrosive for such a metal as iron. If experience should show any considerable disadvantage in this, such corrosive action would only take place with the engines out of action or resting between runs and doubtless could be neutralized by suitable means such as oil or alkaline substances introduced at the time of a shutdown lasting for a period more or less prolonged. Doubtless also a proper selection of materials for valves or valve seats subject to corrosive action would eliminate all difficulty arising, if any exist.

Some Electrical Features of the Cahill Telharmonic System.

By A. S. McALLISTER.

THE issue of the ELECTRICAL WORLD for March 10, 1906, contained an outline of the fundamental characteristics of the Cahill telharmonic system for the generation and distribution of music by means of alternators, and illustrations were given of Dr. Cahill's experimental equipment. As noted

FIG. 1.—TELHARMONIUM KEYBOARD.

in the above issue, a 200-ton telharmonium equipment has been installed and is now in operation in New York. This installation differs in many minor details from the experimental outfit, and a description of its electrical features will doubtless prove of interest at this time.

The alternators are of the inductor type, with stationary armatures, and stationary field coils. The revolving portion of each consists of a massive iron cylinder or rotor with teeth or pole pieces corresponding in number to the frequency of the current desired for each machine. There are 144 alternators, giving currents at 144 different frequencies. The rotors are geared together by toothed wheels so that the relation between the frequencies of the several alternators is absolutely fixed, and the relative tuning is perfectly constant. The frequencies obtained vary from 40 to 4,000 cycles. The alternators as a unit are driven by a 185-hp constant-speed, direct-current motor, the load on which consists almost wholly of the field excitation of the alternators, and averages about 100 hp; for while all the alternators run simultaneously most of them at any one instant are on open circuit. As is well known, the currents from the alternators are superposed in a manner to cause a telephone diaphragm to produce certain musical notes according to the combinations of frequencies used.

Even when one listens to the music produced by the telharmonium and is convinced that the performer is able to change the quality of the tones at will so as to imitate any desired musical instrument, it is to be doubted whether he appreciates the quantity and quality of specially designed electrical apparatus required to make the system complete. When the performer depresses any certain key, there are simultaneously impressed upon the telephone diaphragm vibrations corresponding in frequency to the ground tone of the required musical note and the second, third, fourth, fifth, sixth and eight partials or overtones. The seventh harmonic is also sometimes used. At other times the ground tone is used alone, or it is used in combination with the second harmonic or the third, or fourth harmonic, or the second and third harmonics, or in other combinations, at the will of the performer. The relative loudness of each of these overtones is completely under the control of the performer. When it is known that a single performer on a single keyboard may depress simultaneously ten keys, each serving to produce the corresponding ground tone and its numerous partial tones, and that there are at present two keyboards arranged for two performers so that 20 keys may be depressed at once, and yet each tone and partial tone contributes its share to the resulting chord of composite musical notes, without noticeable interference with the others, some slight idea may be gained of the severe requirements which are met by the apparatus, and of the ingenuity of the designer.

Although each key on the performer's board controls the completion of the main circuits from seven alternating-current generators, the "action" is equally as delicate as that of any piano or pipe organ. This desirable result is secured by the use of a system of relay magnets so arranged that the switch connected to each of the performer's keys handles only a low-voltage direct current for operating a magnet which performs the real task of closing the proper switches in the alternator circuits. There are now in use 144 alternators, as before said; and in each keyboard there are 144 performer's keys and an equal number of relay magnets. These magnets are of the plunger type, the windings consisting of several layers of enameled wire without other means of insulation.

Each relay magnet is exactly similar and equal in all respects

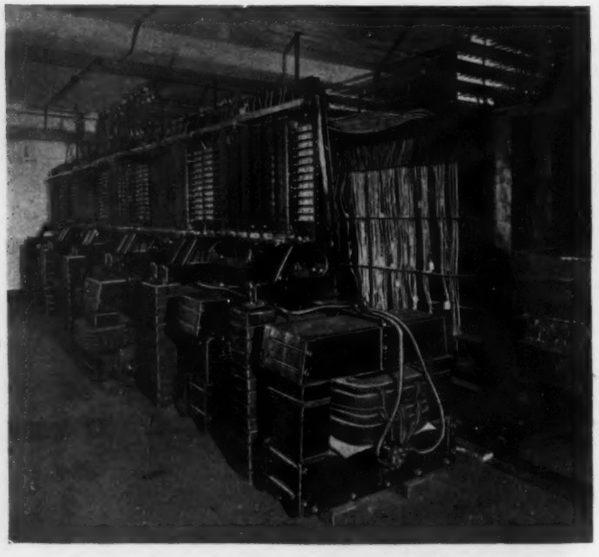


FIG. 2.—A SECTION OF SWITCHBOARD AND TONE MIXER.

to its neighbor, so that each performer's key controls exactly the same value of direct or magnet-operating current as its neighbor, and this value does not vary at any time throughout the operation of the keyboard. The amount of alternating or music-producing current, however, is constantly varying, a

larger amount, for example, being used on the accented beat than on the unaccented.

It may be of interest to note that no special means are required to prevent sparking at the keyboard switches other than a proper design of the plunger magnets. Each plunger magnet lifts vertically a certain strip of wood along which are placed eleven sets of fingers which serve to close certain groups of switches corresponding to the ground tone and overtones of the indicated musical note. The gravitational force on the wood is almost wholly balanced by a certain lever weight against which its lower end rests when it is in its lower position; when the strip is in its raised position it is out of contact with the lever weight. Thus the strip responds immediately when the plunger magnet is energized, and accelerates rapidly to its raised position without retardation, on account of the small mass of the parts moved directly with the strip. In consequence of this construction, no noticeable time elapses from the depressing of the performer's key to the closing of the main alternator circuits. Moreover, the very short interval of time elapsed is exactly the same for all of the keys, and the ear of the most highly trained musician is unable to detect any error in the speed of the "action." In the language of a musician the key "speaks" promptly, the "action" is instantaneous.

As stated previously, there are 144 magnets and each magnet serves to close eleven switches; there are, however, only 144 generators from which current can be obtained, and only eleven circuits to which current is directly supplied. Each alternator (except those of the very lowest frequency) supplies current at a definite frequency for the ground tone at one switch, for the second partial of a note of one-half frequency at another switch, and so on.

By means of an arrangement of bus-bars all of the currents used in producing the ground tones are superposed in one circuit, all of the currents for the second partials are superposed in another circuit, and so on with the other orders of harmonics. The bus-bar circuits pass through the primaries of closed iron magnetic circuit transformers, the secondaries of which are joined in circuit with certain impedance rheostats for governing the strength of the currents. These rheostats are operated by the performer by means of "stops" arranged conveniently near the keyboard.

As a matter of fact, when a certain chord is produced by the performer at the keyboard all of the currents corresponding to the ground tones are superposed electrically through the bus-

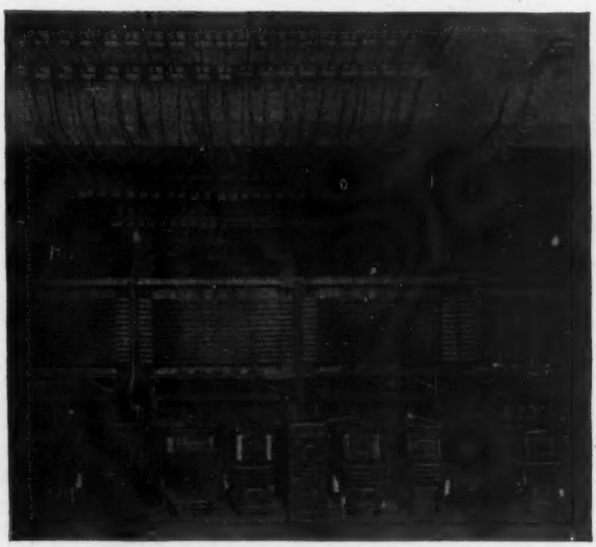


FIG. 3.—SECTION OF SWITCHBOARD.

bars mentioned above; all of the second-partial currents are superposed electrically and so on, for the third, fourth, fifth, sixth and eighth partials, as noted above. The composite ground tones and composite partials are passed through the primaries of the transformers mentioned previously, the secondary currents of which are then superposed electrically. The composite currents thus produced are passed through an impedance rheostat operated by the performer by means of a pedal. The currents are then passed through the primaries of an open iron magnetic circuit transformer in the secondary of which is produced a current in which is represented all of the frequencies corresponding to the several ground tones and partial tones forming the musical chord. The current which flows in this secondary circuit is not the one that is sent out to the different telharmonium receivers, but it is merely the primary current for an air-core transformer, the secondary current of which serves to actuate the diaphragms of the receivers. In some of Dr. Cahill's constructions, however, the currents are sent to the line by a much more direct path.

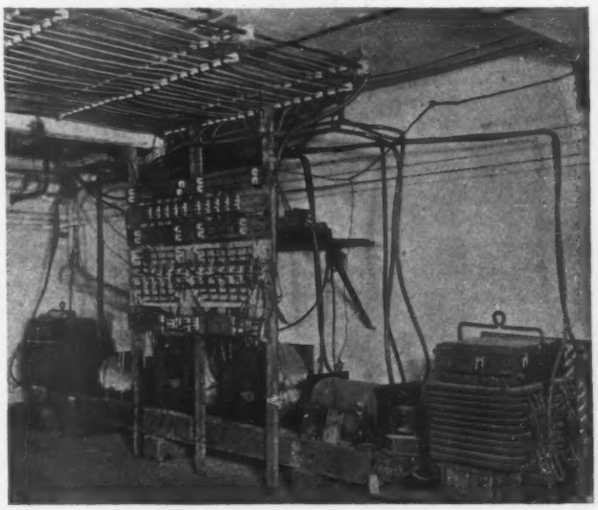


FIG. 4.—VIEW OF TONE MIXER.

The object in employing such a large number of transformations is to combine properly the elemental currents required and to allow the values of the several elements to be properly controlled, and also to remove from the resultant tones all of the feeble but undesirable overtones which would be produced in the superposed currents taken directly from the alternators or from the secondaries of the iron-cored transformers.

Each transformer used throughout the system has been specially designed for its duty. In the case of the closed-iron magnetic circuit transformers, each lamina is definitely separated and insulated from its neighbor, so that the apparatus is as free as possible from eddy currents. Similar precautions are taken with the open iron circuit transformer. The air core transformer serves a double purpose; it assists in eliminating any undesirable overtones and it allows voltages of different values to be selected according to the resistance through which the final telharmonium current is to be transmitted. For the latter purpose the secondary winding is tapped at several points and a transmission voltage is selected of a value depending upon the needs of the case. In the primary circuit of the air-core transformer there are introduced impedance rheostats controlled by the performer, which allow the final composite telharmonium current to be varied at will.

Reviewing now the numerous rheostats, it will be noted that there are eight rheostats for controlling the composition or quality of the note produced by the depression of each key, and several other "expression" rheostats, for giving "soul" to the music. By the use of the "stop" rheostats the performer is enabled to introduce such of the "overtones" or "harmonics" as he may desire, and thus he can imitate at will the notes of the flute, the cornet, the oboe and a variety of other instruments, including instruments as strikingly different as the bagpipe and the violin. The combination of "stops" employed determines the "timbre" of the note, but has almost no effect

on the loudness, which latter is governed by the expression rheostats. Each rheostat has been the subject of careful study and has been designed especially for the work it performs. Each "stop" rheostat consists of a collection of iron-core impedance coils with their windings connected permanently in series, the junction points being brought out to a smooth rheostat surface formed of alternate strips of copper and mica. The contact device which plays over this surface is made in several parts, each held in place by means of a spring, so that an open circuit is practically an impossibility. Each expression rheostat is built up of separately insulated impedance coils, whose terminals are brought out to a row of contact levers. A frame, manipulated by the musician, who is playing, operates these contact levers, so as to connect the required number of impedance coils in parallel and thereby vary the effective impedance in circuit. These expression devices are operated constantly by the performer. Even while a single musical chord is being produced he varies its attack and sostenuto as a violinist does with his bow; but as a general thing the stop rheostats are set once for all for each musical phrase, as is true of organ stops.

It is believed that the above outline will give a fair idea of the numerous problems encountered and successfully solved by the inventor of the telharmonic system, and will indicate a few of the developments which have already been undertaken by him. Our readers will be interested to learn that distributing cables have been laid along Broadway, New York, from Twenty-third Street to Forty-fifth Street, and along Fifth Avenue from Twenty-third Street to Thirty-fourth Street, and that outlets have been placed at various places on Broadway and Fifth Avenue and the adjacent streets.

The description above given applies for the most part to a single keyboard only, with the switches and expression devices belonging to it; that is, for each keyboard there is a switchboard connected with the keyboard through the relay magnets,

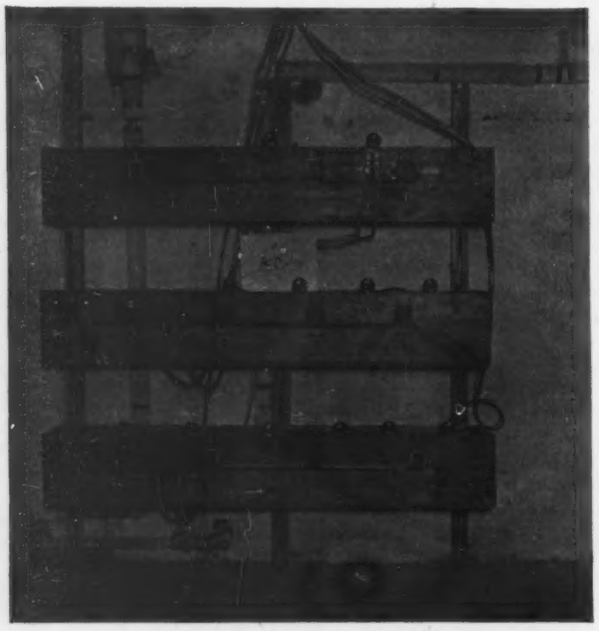


FIG. 5.—"THE DOUMA," THE COLLECTION OF SILENCED VOICES.

and controlling by its switches the action of the alternators on the transformers and tone-mixers or vibration combining devices above described. And this brings us to one of the most striking features of the electrical music, which is that a number of switchboards and keyboards are connected with the same set of generators. By their timbre-controlling devices the several keyboards may be made to give the same quality of tone, or widely different qualities, though fed from the same alternators. Thus, by mixing the harmonics of different tones in varying proportions, the musicians can give to one keyboard a wood-wind quality like that of the clarinet, to another keyboard the quality of brass, or if desired, a quality similar to that of the 'cello. There are now two keyboards in operation at the plant at Thirty-ninth Street and Broadway, but additional ones are building in Dr. Cahill's laboratory at Holyoke, and will be put in service in the plant in New York, it is expected, in two or three months. Also some other of the many expression devices worked out by Dr. Cahill will be put in service in the plant in New York at an early date.

Any one who listens to the players will recognize that electrical music, without imitating, has the power to produce tones of many different qualities. Some of these tones are so like the leading tones of the orchestra—clarinet, oboe, French horn, 'cello, etc.—as to deceive a good musician; that is, a musician who did not know that the sounds were produced by electricity would feel sure that they were produced by the usual instruments of the orchestra. Moreover, the telharmonium has beautiful qualities of tone never heard before, and resulting from the power which the performer has to mix the harmonics or overtones with the ground tones, in any desired proportions. Also, the attack and sostenuto of the instrument is surprising, in that at one instant it closely resembles wood-wind, at another brass, while at another one hears the bow on the string—according to the effect the performer wishes to produce.

In its novel and singular power of controlling the timbre, the attack and the sostenuto, the electrical music differs from all the existing instruments of music and in a measure combines in itself the powers of the best instruments of the orchestra. Careful tests show that this remarkable instrument has sufficient electrical power to produce a musical effect of comfortable loudness like that of a violin or piano in more than 10,000 places simultaneously. It would not, of course, be able to supply so large a number of hotels or public places, each of which in general would require as much electrical power to fill its large halls and corridors, as several private residences of the average size.

Another striking thing about the Cahill plant at Broadway and Thirty-ninth Street is that a musical apparatus of such novel and singular powers should have been brought to such a degree of perfection in the first large instrument built. The fact that progress in an art is usually a gradual evolution—by small steps and slow stages—is so well known and so often spoken of as to be almost axiomatic. From Hero, who first proposed to utilize the motive power of steam, to Watt's successful engine was almost 2,000 years. And between the proposal of Hero and the accomplishment of Watt many inventors in different countries made ineffective attempts to attain the goal desired. From Huyghen's proposal of an explosive motor to Otto's successful machine two centuries elapsed, with scores of patents in the different countries of Europe. So from Sir Humphry Davy's experimental arc to the Brush and Edison arc lighting machines, three-quarters of a century elapsed, during which scores of inventors in different countries endeavored to solve the problem in vain. Similar remarks apply to the progress of most great inventions, electrical and mechanical. But the process of producing music from dynamos has been carried from the first conception to the successful working machine by one man—Thaddeus Cahill—in a few years. And when one hears the plant at Thirty-ninth Street and Broadway, with its musical tones already equaling, if not surpassing, the instruments of the orchestra, one wonders what cannot be expected in a few years to come, when the inventor will have had time to do his best and when his work in all its details will be known to the world, and open to improvement by others, and when musicians will have learned to use the new powers which electricity is placing at their command. Clearly the world has, through the wonderful powers of the electric forces and the skilful use made of them by Dr. Cahill a new music, a music which can be produced in many thousand places simultaneously, and which in its very infancy seems destined to surpass in sympathy and responsiveness—in artistic worth—the existing music of pipe and string—the evolution of many centuries.

Engineering Education.

By B. A. Behrend

IT is with considerable apprehension that I have accepted an invitation to contribute to the columns of the ELECTRICAL WORLD my views on engineering education. However, the subject matter is one to which I have given years of careful thought and one which I have learned to like for its own sake as well as for its great importance and, when I here repeat the editor's courteous invitation, I do so with the purpose of presenting my credentials, as it were, for undertaking this task, though I am fully aware that I lay myself open to the accusation of egotism in so doing. "I feel," he says, "that with your knowledge of both the European and American situation and the broad view which you are capable of taking of any subject, what you would say concerning the present status and the future of the electrical engineer would be read with utmost interest by our readers. A point which I think it would be interesting to bring out is the adequacy of the present methods of electrical engineering education, pointing out any weaknesses which you think exist and making suggestions as to improvement. As a rule, the advocates of engineering education are rather one-sided in their views, while critics are apt to be from among those who have not given the subject any broad consideration. You are one of the very few that we know of who could review the subject thoroughly from both the scholastic and practical standpoints, and we, therefore, think that such an article from your pen as proposed would be a valuable contribution to the subject."

Though the editor's words may have been slightly colored by ten years of friendship, which it has been my great fortune to enjoy, I feel that, besides the great interest which I have always taken in the subject of education in general, my studying in European universities, and my lecturing in some of the great universities in this country and Canada, have given me a good opportunity to observe. On the other hand, as chief engineer of a large manufacturing company, I have had, for the past seven years, plenty of opportunity to come into intimate contact with, and to employ, a large number of the graduates of European and American universities.

I will preface this article with a quotation from an address on medical education which that great English biologist and keenest of observers, Prof. Thomas Henry Huxley, delivered some thirty-six years ago to the students in University College, London, and I will take the liberty of substituting for the words "medical education," the words "engineering education":

"I will tell you what has struck me," said Prof. Huxley, "but in speaking in this frank way, as one always does about the defects of one's friends, I must beg you to disabuse your minds of the notion that I am alluding to any particular school, or to any particular college, or to any particular person; and to believe that if I am silent when I should be glad to speak with high praise, it is because that praise would come too close to this locality. What has struck me, then, in this long experience of the best men best instructed in engineering, taking it as a whole, and broadly, is the singular unreality of their knowledge of engineering. Now, I use that word 'unreality' advisedly; I do not say 'scanty'; on the contrary, there is plenty of it—a great deal too much of it—but it is the quality, the nature of the knowledge, which I quarrel with. I know I used to have a bad reputation among students for setting up a very high standard of acquirement, and I daresay that you may think the standard of this old examiner, who happily is now very nearly an extinct examiner, has been pitched too high. Nothing of the kind, I assure you. The defects I have noticed, and the faults I have to find, arise entirely from the circumstance that my standard is pitched too low. This is no paradox, but quite simply the fact. The knowledge I have looked for was a real, precise, thorough, and practical knowledge of fundamentals; whereas that which the best of the candidates, in a large proportion of cases, have had to give me was a large, extensive, and inaccurate knowledge of superstructure; and that is what I mean by saying that my demands went too low and not too high."

It is my opinion that these remarks apply with great force and justice to the condition of engineering education of to-day. I feel almost tempted to take this excerpt from Prof. Huxley's lecture as a text, upon which to deliver the sermon. I also wish to beg my readers to disabuse their minds that I am alluding to any particular school here or abroad; I also wish to state that my silence on many features which are good is due to the praise coming too close to this locality; I also have been struck with the singular unreality of engineering knowledge displayed by engineering graduates, and I have been struck with a certain volubility and prolixity of knowledge, and a want of a "real, precise, thorough and practical knowledge of fundamentals." In pondering over this state of affairs I have been impelled to acknowledge, at least to myself, that the fact that Prof. Huxley's statements, made to medical students thirty-six years ago, applying so singularly well to engineering students of to-day, cannot be a matter of mere coincidence. It would, therefore, appear as if the difficulty involved is deep-seated and, perhaps, irremediable. Let us look at the conditions of engineering education with as little bias as possible. We are all prone to hold a brief for some school or university, believing unconsciously, though perhaps not admitting it, that a school to which such great luminaries as ourselves have owed their education, must surely be a good school. In considering this subject we have to consider the three elements which enter into education, viz., first of all the teacher, secondly the student, and last and least the school. I heard President Jacob Gould Schurman, of Cornell University, say from the rostrum, to a great assemblage of people, upon the introduction into office of a new president of a university, which had been ridden by politics and in which almost any other consideration, excepting that of competency, had entered into the selection of teachers, that a great university was made not by the board of trustees, not by the president, but by a competent faculty. Though this may sound to any thoughtful person like a truism, yet it is a fact usually forgotten and disregarded. We must have good competent teachers, and there is no doubt that such good competent teachers can be obtained and that a great many universities, both in Europe and in this country, already possess them. The inspiration which students obtain from great masters in their professions is infinitely greater than the benefit which will come to them from having studied in palatial buildings, built by, and dedicated to, men who have been favored by fortune in the great struggle for wealth, which well-nigh obscures to-day the engineering side of industry. If I may here speak of a matter thoroughly personal, I do so with the knowledge that those of my readers who have had the good fortune to have been influenced by great men, both in their studies and in their views of life, will be in full accord with my remarks. The influence which some of my revered teachers, as Hermann Helmholtz, Gisbert Kapp, Riedler and Slaby, have had over me; the knowledge and inspiration which have come to me from the earnest study of the works of John Stuart Mill, Charles Robert Darwin, Thomas Henry Huxley and Andrew Dickson White, are the factors which have counted for something in my life, and I confess that I have altogether forgotten the architecture of the buildings in which I have studied as well as the names of those who built these structures. It seems to be commonly assumed by those who have never done much scientific or engineering work themselves, that it is the building and equipment which are the essential features of, and the foundation for, good engineering education. Poor workmen always quarrel with their tools; poor teachers naturally quarrel with their equipment. Both in Europe and in America there prevails a tendency to build palatial universities instead of plain dignified structures and, as the building of these expensive structures places the university under obligation to their munificent builders, the trustees and other officers connected with the school thus endowed by rich men will endeavor to apologize for, if they do not countenance, the methods by which their patrons have acquired their wealth. Although this circumstance alone would

be sufficient, in the opinion of most right-minded people, to carefully consider the wisdom of accepting endowments from individuals implying obligation on the part of the university, it must further be considered that these large institutions require considerable sums of money for their upkeep and, therefore, funds are continually required by these institutions which would not be forthcoming, unless the officers of these institutions at least remained silent in regard to such of their ideas as might offend their benefactors. But there is another argument which I deem even more irrefutable than the previous one, i. e., the fact that a well equipped institution can much more readily get along with poor teachers than a poorly equipped institution. In this connection it may not be amiss to mention that some of the greatest experimental discoveries in natural science have been made in laboratories which were poorly equipped, even considering the time when these discoveries were made. I have merely to mention the experimental researches of Michael Faraday and the remarkable achievements of Justus Liebig to make us realize that there is no proportionality between the equipment and the discovery. Some of the great achievements of modern science have been made in laboratories which were by no means equipped in a remarkable way. The researches on electric waves by Heinrich Hertz and the work of Rutherford were carried out in laboratories which, from the modern standpoint, were anything but complete in their equipment. Again, when I think of the miserable testing department at the Oerlikon Tool and Engine Works, in which Mr. C. E. L. Brown did some of the finest electrical engineering work a score of years ago, I state with great emphasis that I can see no proportion whatsoever between equipment and results. Instead of inciting the inventive qualities, a complete equipment keeps these faculties dormant; instead of stimulating both the teacher and the student in the devising of methods for the demonstration of laws of nature, an air of indolence is inspired by the fact that you simply have to go to a piece of apparatus to have it perform for you, without effort, what can be learned only by the earnest application of the mind. Thus, I am compelled to see in the large endowments of universities, a blessing of a very questionable nature. Philanthropy has done much good to be sure; but it seems as if for every six penny's worth of good, it does a shilling's worth of harm.

There is another disadvantage which usually follows in the wake of these large endowments for buildings, viz., the fact that the funds left are too small to engage competent and talented men to take charge of the teaching. President Schurman's statement that it is the faculty which makes the university must be accepted as an axiom. It is all very well to say that teachers should be of frugal habits and set an example of simplicity to their students. This is unquestionably true and the man who lived a life of luxury would probably be morally and intellectually unfit for his position as a teacher. But it is disregarding all common sense, and also the realities of life, to expect to be able to obtain the services of a man qualified to instruct and to direct younger men in a difficult scientific profession, to work away all his life upon a salary which hardly enables him to give his children careful education and to save for his old age. It has thus come to pass that men who have been shipwrecked in their professions in life have sought a haven in teaching but, hard though it may sound, this class of men is just the class of men which should not be permitted to teach. More and more, the educators of Europe begin to realize the necessity of employing the highest talent obtainable in scientific teaching. In medical science, for some score of years past, the greatest practitioners have been chosen as teachers; in the legal profession, the foremost lawyers have been selected as teachers of the law in the universities; and, similarly, some of the most eminent engineers have been called to chairs in the technical colleges, in which positions they have the opportunity of still practicing their profession and yet giving the younger generation the benefit of their wide experience and knowledge. A step very much to be admired has recently been taken by Sir Oliver Lodge, Principal of the University of Birmingham, in calling Mr. Gisbert Kapp to the chair of electrical engineering. Thus the University of Birmingham has not only complimented a great engineer, but it has obtained the benefit of the vast experience at the disposal of Mr. Kapp. It must be distinctly understood that these prominent practitioners, whether in the medical, legal, or engineering professions, are not required to devote their entire time to teaching; on the contrary, by so doing, they would incapacitate themselves altogether for teaching. Only continual contact with actual practice will wear off that unreality of which Prof. Huxley complained in his medical students, and of which we complain in engineering students. You cannot be a master of surgery if you confine your practice to the cases in the university hospital; and no more can you be a competent engineer if you are not in close contact with engineering problems of the day all over the world.

This matter is really one upon which a great deal of thought should be bestowed. The average student who goes to the university to be taught, represents by no means the fair average of intelligence of the nation. It cannot be denied that a large moiety of our young men, especially those of keen intelligence, see in the avoiding of a university education a short-cut to fortune. Our industries are growing more and more commercial; the engineering work requiring real ability is done by a comparatively small number of men, and the most lucrative positions are usually not in the engineering professions. Thus, men of some ability, keen to see their own advantage, see opportunities ahead of them as good as those obtainable by the graduates of our universities. Let us see if we cannot gain some light on the much controverted question of the necessity of a college education by considering the history of education in Europe, since more experience has been gained in this direction on the other side of the Atlantic than on this. Germany has always been looked upon as the country of scholasticism. The people have a strong proclivity to intellectual pursuits. The German mind is naturally pensive, given to idealization and fond of study. Thus every little town has had its university for a hundred years or more, and the most respected citizens are the teachers of these universities. Theology, law and medicine, and the physical sciences are more or less peacefully taught, side by side, in buildings which inspire reverence on account of their antiquity, but which, in all other respects, are marked for simplicity. The teachers in these universities are usually earnest men, devoted to their professions and spending their lives in their lecture rooms and laboratories. It is not at all uncustomary to see men of three score years and ten, and over, still teaching with the same enthusiasm which they evinced when they were young, and probably much more enthusiastic than most of our young teachers in these modern days. While these men may be somewhat antiquated in their methods, the inspiration which the students obtain from listening to these old masters is something that could not be given them in any other way. Helmholtz was seventy-three years old when he died and he was then still teaching; Bunsen was over eighty, while he still taught at Heidelberg; Lord Kelvin only recently retired from teaching, and there are a host of others who have grown venerable in teaching.

The rapid and stupendous growth of the manufacturing industries required the training of young men in the applications of physical science. The universities were not able to cope with this problem. The scholastic influence which had reigned in them for centuries made them look with a certain measure of disdain upon the technical sciences, which seemed to stand only for utilitarian ideas and material profits. Scientific researches which used to be carried on for their own sake and for the inherent interest which the investigator took in them, began to be considered as unpractical and useless by the large host of students and their rather imperfectly trained and educated teachers. Doctors of science who were unable to obtain chairs at the universities would become professors in the technical schools. There was for a time a strong antagonism between the university and the polytechnic institute which was not only quite comprehensible, but also justifiable. The scientific investigator knew very well that it was impossible to predict the far reaching importance of a scientific investiga-

tion and that, therefore, this everlasting query, "What's the use?" was indicative of the short-sightedness of the questioner. On the other hand, the practical man with a smattering of science, soon got the best of the argument by putting his limited knowledge to material use. The large number of universities had already created a class of educated men which formed something like an educated proletariat, for whom it was hard to find employment. The universities had produced a class of men of large learning but little power of application of this learning to the problems of life. It has often struck me that many of these learned Germans do not possess their knowledge, their knowledge possesses them!

But in the course of time the polytechnic institutes, which are very like our universities in this country, have molded their institutions along the lines according to which the universities had built up their faculties. The teaching of steam engineering, of statics, or of hydraulics was no longer left to men who had actually seen a steam engine once in their lives, or passed a bridge, or seen a dam, but to men who had built steam engines, had designed bridges, and had constructed dams, just as the teaching of theology and of law and of medicine had been entrusted to great ministers, great lawyers, and great surgeons in the old universities. The old principles were all right but the universities, fossilized through ages, refused to apply them consistently to the new field,—the polytechnic institutions of learning in which not only the science of engineering but the pure sciences, which are applied to engineering, found a stronghold. It did not take long to discover that numerous technical problems rendered infinitely better illustrations of scientific principles than the vague and unreal examples which were offered by the schools to illustrate the great laws of nature. Speaking with particular reference to our own profession, it was readily seen that the telegraph, the telephone and the dynamo electric machine offered the most interesting and instructive examples of the theories of electromagnetic induction of Faraday and Maxwell. I believe I am right in stating that, without these applications, a general acceptance of these theories would have been very much longer delayed. The mathematical theories of Fourier found beautiful illustrations in electric phenomena, and reality was given to mathematical speculations which appeared almost like phantasmagoria without these illustrations.

Despite the inroad of "commercialism" into engineering, there never has been such opportunity for the application of engineering ability as there is to-day. It is quite true that many manufacturing concerns, especially those which are favored by a monopoly, have come to see that they can make large profits in adhering to developed lines of apparatus and in admitting as few changes and improvements to be made on this apparatus as is compatible with large sales. This tendency is surely feasible but it is not likely to be permanent, as the concerns in which such disregard for continuous progress is carried into effect will, sooner or later, go to the wall. To illustrate the point I have in mind, take a concern which employed a capable engineer at one time who developed a line of electric motors. A short-sighted policy would consider the manufacture of this line of apparatus to the exclusion of improvements the most successful way to make money. This policy would enable the abolition of a designing department and the organization would consist of a factory and a sales department. For some years business would be satisfactory, until such time as improvements had been made by less retrogressive concerns, when it would have become impossible to sell the old and unimproved machines. We frequently see illustrations of this policy of concerns enjoying at one time a great reputation, but suddenly losing their business prestige on account of their lack of progressiveness. The successful manufacturing concern must provide for continual improvement of its apparatus and, for this purpose, part of the profits obtained from the manufacture of standard apparatus must be used.

There has been a great deal of foolish talk on the subject of "commercial engineering." We hear every day men, thoroughly incompetent to discuss such matters, glibly labeling engineers "scientific engineers" and "commercial engineers." It is difficult to know what is meant by either of these expressions. The work of the engineer should consist in the careful designing and building of apparatus so that it performs its functions safely and with the least possible waste of both material and power. Machinery designed by such an engineer is machinery which is designed scientifically, and it is machinery which the salesman will have little difficulty in disposing of. I am sure that this must be what some people mean by calling an engineer a "commercial engineer." But be it always remembered that such successful engineering is strictly the function of the scientific engineer. Careful and honest engineering is always "commercial" and, although poorly and dishonestly designed and manufactured machinery may yet be successfully sold for a time by an acute salesman, such condition cannot last. I believe that, in this commercial age, we cannot put too much emphasis upon the necessity of the engineer being a bulwark against the continual onslaught of the commercial man for the sake of cheaper and, therefore, poorer machinery. It is a menace to the industry of a country to see engineering quality disregarded and to have machines selected according to price rather than according to quality. Imagine the equipment of a man-of-war to be made in the cheapest possible manner! Imagine the guns and firearms to be beautifully polished and not made of good material! Imagine the high speed steam turbines and electric generators to be designed poorly and to be made of poor material and workmanship! And yet these are exactly the conditions which would be brought about if the engineer permitted the inroad of "commercialism" into his profession. This brings me to another point. The necessity of the engineer possessing a strong and determined character which enables him to brush aside the opinions of those who lack the insight and the experience, the knowledge and the ability, to weigh difficult and responsible engineering problems. I have heard men who ought to know better define an engineer as a man who can do for one dollar what another man can do for two; unquestionably, an engineer worthy of his name is capable of doing this, but how foolish to consider the province of the engineer thus limited by this sagaciously silly phrase! Men who spring such catch-phrases upon the public are at fault for the singular lack of esteem in which the engineering profession is still held in many quarters. Speaking for the moment with particular reference to the electrical engineer and his work, I would say that, while he shows his ability in designing a ten thousand kilowatt generator with the amount of material used five years ago for a five thousand kilowatt generator, he simply could not have formerly designed a ten thousand kilowatt generator at all until he had learned how to use the materials at his disposal to better advantage. His object has been to condense into smaller space a power unit which was needed for some particular purpose, and not at all to do with one dollar what anyone else could have done with two. Often the saving of material that would appear merely a commercial advantage to the uninitiated, is the only means by which a certain engineering result can be accomplished. The reduction of mass in the reciprocating parts of high-speed steam engines is more essential for engineering reasons than for commercial; the high induction in parts of the magnetic circuit of electric generators and motors is one of the most efficient means for obtaining good operation, saving also in the amount of material used. So it may be said, without being paradoxical, that sometimes the engineer cannot accomplish for two dollars that which can be accomplished with the expense of only one dollar. Engineers who have no creative ability often believe that they have done great work by cutting out a few thousand pounds of cast iron from a fly-wheel of an engine designed some years ago by some great engineer, and having proved to be somewhat too conservative; or by saving a little cast iron in the yoke of a generator designed by some other man which has since been found to be amply strong in rigidity. What would such men have done if they had had to do the original work? But as there are plenty of quacks in the medical profession, so there are plenty of quacks in the engineering profession. The medical

quacks usually make plenty of money and plenty of noise; and so do the engineering quacks. It behooves the engineering societies, the engineering clubs, and the engineering schools to plainly stigmatize the engineering quacks, just as the medical societies in the medical profession have stigmatized the medical quacks. In France there has existed for many years a custom of giving a technical education to lawyers and statesmen. I believe that at the bottom of this lies the realization of the fact that a scientific education enlarged and made real by the application of science to engineering problems, gives men that power of observation which is, in my opinion, the most important feature of any educational training. We obtain our knowledge from nature by observation, and those who cannot observe and draw correct inferences from their observations cannot aid in the progress of science and engineering.

The matter of greatest importance which I have endeavored to bring out and upon which I wish to dwell particularly, is the necessity of engaging the most eminent engineers as teachers. This can readily be done if they are granted enough time to still pursue their professions. It should then be left to these men to train the associate professors and instructors whose entire time should be devoted to the supervision of the students. This one step would work a revolution in the methods of teaching. By thus closely bringing together the man who teaches pure mathematics, abstract dynamics, and abstract physics with the practical engineer, both will profit considerably. The abstract teacher will obtain examples for his students from the practical man and, conversely, the practical man will remain in touch with pure theory. The practical engineer will insist upon the students learning to sketch, to draw, and to work out problems in a thorough and responsible manner. If there is any one defect more obvious than another in the training of the graduate students, it is the utter failure to appreciate the seriousness of responsibility down to the slightest detail. Their handwriting is illegible; their figures are confused; their sevens look like their twos; they cannot letter; they cannot sketch; they cannot draw; they cannot count the speed of a machine accurately; and all these things do not seem to have even been impressed upon them as being of importance. Their disregard for decimals is appalling, and what that means I need not dwell on at length. A stress in a certain part is figured at two thousand pounds per square inch, when it should be twenty thousand pounds; the resistance of a winding is .02 ohms when it should be .002 ohms, and so on I could multiply examples without end. Most of the manufacturing concerns have been obliged to institute regular training schools for these young men in which it is the endeavor of the instructing engineer to make the young men unlearn much that they have learned, so as to make them receptive for our methods. When you mention to some college professors the necessity of the students being trained in sketching and drawing, answer is made that the universities do not care to educate draughtsmen. This is a silly reply. The engineer should be a competent draughtsman, though he need not spend his life at the board. He must be capable of representing quickly an idea in the shape of a diagram or a sketch.

There should be little difference between the education of the electrical engineer and the mechanical engineer. Electrical engineering is but a branch of mechanical engineering. Who would want to educate "thermo-dynamic" engineers? and yet this would be no more absurd than to educate electrical engineers. The sooner we recognize the fact that successful electrical engineering is synonymous with successful mechanical engineering, the better it will be. Thirty years ago the designers of telegraph instruments turned their attention to dynamo design and did not make much headway. It was not until such men as C. E. L. Brown and Gisbert Kapp developed electric apparatus along mechanical lines that the era of heavy electrical engineering began.

The more theory in college the better! The students cannot receive good practical instruction at college, hence let them get as much theoretical training as possible. Mechanical laboratories are very well and better than football, but they do not at all take the place of a year's training in a shop. It is customary in Europe that engineering students work for at least one year in a shop before entering college, and this seems to me preferable to our custom of allowing the students to work in the shop after graduation. The explanation of the European system is found in the fact that the engineering teachers, themselves practical men, have found it difficult to teach young men who have had no shop training. The more shop training the better. It is foolish to have young men design apparatus which nobody can build rationally with the tools and the machinery at the disposal of a large manufacturing plant. Let the high school graduate work in a machine shop, according to his ability and inclination, for one or two years and let him be thrown into contact with working men, their methods, and their lives. It will do him good in his future work and it will show him how easy it is to make a drawing, and how difficult it is to build the apparatus according to such drawing. He will become thoroughly awake to the problems which the practical men have to solve and he will be a much better and brighter student in college, keenly appreciating the tremendous assistance rendered him by sound theory.

American universities are very rich in comparison with European schools, but the disbursement of their funds should be with a view to obtaining good teachers rather than obtaining magnificent buildings and equipment. As soon as brilliant and competent teachers, who have shown their mettle in life, obtain a foothold in these institutions of scientific engineering, they will work out their own salvation.

I have alluded in passing in this paper to the necessity of a sound moral training in the young engineer. Having entered life, he will be confronted with temptation at every step. To cheapen his designs, he will be tempted to use poor materials leading to disastrous results; he will be tempted to make better guarantees than he can obtain, owing to the pressure from competition; and, most abject of all, his influence will be coveted for the obtaining of large contracts in the letting of which he has a voice. Such crimes will be more flagrant in him than in the ordinary business man. The latter cannot plead the inspiration and the example of the men of science, to which we owe the sources of our knowledge. There can be no better foundation laid in the minds of these young engineers than is given them by the example of the long line of brilliant scientific men who, like noble ancestors, should inspire them with the dignity and grandeur of their profession. Let them read the lives of great scientific men; let them admire the keen intellect and the devotion to scientific work of Galileo, of Leonardo da Vinci, of Newton, of Faraday, of Helmholtz, of Kelvin and of Huxley. Let them emulate the example of great engineers like Siemens, Rankine, Hopkinson, Bell, and other men whose lives are an inspiration, and they will be steeled against the perverting temptations of their profession.

Mr. Andrew D. White, co-founder and first president of Cornell University, that great American institution of learning which stands out as the first university in this country, in which the teachers were chosen without regard to sectarian leanings, said once that "our great disease is indifference—indifference to truth as truth, and the little army of scientific men furnishes a precious germ from which better ideas may spring, and," the great educator proceeds, "we should strengthen them. We have already multitudes of foundations of appliances for the dilution of truth—for the stunting of truth—for the promotion of half-truths—for the development of this or that side of truth. We have no end of intellectual hothouse arrangements for the cultivation of the plausible rather than the true; and therefore it is that we ought to attach vast value to the men who, with calmness and determination seek THE TRUTH, in its wholeness, on whatever line of investigation, not diluting it or masking it. Their zeal, their devotion, their faith, furnish one of those very protests which are most needed against that low tone of political ideas which, in its lower strata, is political corruption. Their life gives that very example of a high spirit, aim, and work, which the time so greatly needs!"

Technical Graduates and Central Stations.

By Prof. Geo. D. Shepardson.

WHY are so few technical graduates connected with central stations? The question is frequently asked. The answers are diverse. The monotonous routine, the low salary, the slow advancement and the lack of appreciation of true worth, the greater attractiveness of other fields and better opportunities for growth, are the common answers. On the other hand, there are tendencies which make the central station field more and more attractive.

The large manufacturing companies have long ago become convinced of the desirability, even the necessity, of having a corps of technically trained young men to keep their product up to the highest standard of excellence. They recognize that the manufacturing companies must lead the market; that they must develop new and better equipment to meet the increasing demand of modern business. They recognize that the electrical art has developed to the point where the highest degree of scientific training is both desirable and necessary for the evolution of advance steps. Their practical faith in the value of technical men is shown by the fact that each one of at least three electrical manufacturing companies took more than one hundred fresh technical graduates upon its payroll during 1905, and that in spite of the large increase in the number of men graduating from the technical institutions, call after call went out for more graduates. They recognize that while the fresh graduate may not be worth much at first, he has the mind and the training necessary to develop quickly into something of value, so that the money spent on his apprenticeship is well invested by the company.

The constructing and supervising engineering firms recognize the value of technical training, and they secure the services of an increasing number of young men. Their work appeals strongly to many who do not care for factory life nor for station operation. It brings the young engineer into close touch with the newest and best products of various companies, and there is a certain charm about the development of new resources.

At least two causes lead to an increasing attractiveness of central station work for technical men—the greater complication of modern power house equipment, and the growth of syndicate ownership.

The modern power house with its large units, its distant control switches, its synchronizing devices, power factor indicators, static arresters, sub-stations with their auxiliary apparatus, calls for the supervision of men who know not only how to carry on the regular routine, but who understand the function of each part of the equipment and its relations to the whole. It requires men who can anticipate the conditions which are liable to cause emergencies, and who can thus reduce to a minimum the likelihood of their occurrence. It requires men who cannot only understand printed or verbal directions for the proper operation of the equipment, but who can analyze the reasons for the practice. It requires men who can determine the best methods of handling new equipment without costly accidents and delays.

The growing company which is operating the older class of equipment, as well as the company which is free from some of those limitations, finds increasing need for technical skill. Large changes of equipment frequently are entrusted to engineering firms with excellent results, but there is much that requires the attention of a competent resident engineer with competent assistants. Local conditions are best understood by those on the ground. Many of the companies find that the design of sub-stations, switchboards, the layout of main and auxiliary apparatus, the choice and installation of new equipment in their own plants, as well as the proper consideration of the special requirements of customers, can be handled best by their own engineering department.

The comparatively small central station offers a field for the trained engineer, for the reason that it is the most neglected. The small amount of business, high operating expenses and small profits do not seem to warrant the employment of very high talent. If the operating engineer keeps the plant running so that customers are reasonably well satisfied, the owners usually feel that he is doing the best possible under the circumstances.

The business end of the central station is sometimes operating under similar conditions. The writer knows of one instance where a fresh technical graduate took charge of a small plant of not over 100 kw output, and by correcting poor engineering and business methods effected a saving of over two thousand dollars annually above his own salary. In another case a graduate with an experience of one year in managing another plant effected a saving o fabout five thousand dollars annually in a plant of 200 kw capacity. The owners of small central stations do not always appreciate the true economy of good engineering, having a suspicion that men with training in theory are necessarily permeated with new-fangled and visionary ideas that are not bread winners. It is of course condeded that some are.

Owners of large central stations are generally men who appreciate to some extent the value of good engineers. They have some acquaintance with the exjerience and practice of the manufacturing companies. They see that they must have men in immediate charge of their properties who have both practical and theoretical knowledge. One result of the consolidation of operating companies under the control of syndicates has been the recognition of the value of technically educated men to supervise the operation of the stations and their related local interests. This follows not only from the different character of the property.

It has been well said that almost any material may enter into the construction of a small one-story building, but as the stories of the modern office building mount up into the air, it is more and more essential that only proper material be used, especially in the framework. Likewise, the merging of many scattered plants under the control of syndicates requires the more careful supervision of each plant to the end that it may be operated under the most profitable conditions, that its business may be increased to the greatest extent, that every source of loss and of danger may be reduced to a minimum. The elimination of local ownership and the personal oversight of the owners require a higher degree of skill and diligence on the part of the resident manager than before.

Syndicate ownership of various electric light interests usually makes available the capital necessary for desirable improvements impossible under former ownership with limited resources. This not only renders desirable the employment of more technical men, but also makes the position more attractive to them. In a large company there is apt to be less of favoritism than in the small concern; there are higher positions to be won and more opportunities for advancement.

The low standard of remuneration remains as one of the objections to engaging in central station work. Unless the engineer gets into close relation with the financial end of the business, his talents are very apt to be undervalued. In central stations, as indeed in other lines of electrical industry, the man is most highly valued and salaried who is in most immediate relation with the dividends.

The contract agent of the electric light company who secures new business and thus apparently swells the dividends is accounted of more value than the careful engineer who makes possible the proper operation of the plant and who really is responsible for the good name of the company, that after all is the greatest factor in securing more business is remunerated above the designer and factory superintendent whose skill and faithfulness make and maintain the good name of the goods. This ought not so to be. When the owners give due credit and financial recognition to the engineer behind the works, more good men will feel like spending their lives in manufacturing and in operating.

The Rudiments of Illumination.

By Dr. Louis Bell.

THE proper choice and placing of illuminants is a subject that should be of particular interest to the central station man, since these things determine the practical value of the goods which he is selling. Many a disgruntled customer owes his grudge, not to the quality of the light he has purchased, but to his own improper use of it. It is much as if he had bought a razor, systematically stropped it on his doorstep and then had brought it back complaining that it did not cut well. In artificial illumination, whatever its source, three conditions must be met in order to insure good, practical lighting. First, there must be enough light to see by, considering the work in hand. Second, the light must be steady, and third, it must be suitably placed. A fourth condition—suitable color—must be added in many cases, although for most purposes the question of color is rather æsthetic than utilitarian. When color becomes important as a practical question it is often highly important; in fact, the controlling consideration.

Now, as to the amount of light required, the properties of the eye with respect to seeing settle the matter. It is fortunate, or, rather, a necessary result of evolution, that the eye can see for all practical purposes equally well throughout a very wide range of illuminating power, over a certain minimum. This minimum is not a rigidly fixed quantity, for eyes vary somewhat in themselves as between eye and eye, and also from time to time. It is not much in excess, however, of one foot-candle of illumination. At greater intensities there is some gain but not a great deal. Work on dark or ill-defined object requires very bright illumination, not because the eye gains much, but because the important thing is the light which reaches the eye *from the objects viewed*, irrespective of the light elsewhere. Hence, a dark object which reflects light very badly must have very strong illumination in order to be able to pass along the required minimum to the eye. Owing to this a large factor of safety must be allowed in lighting a space for unknown uses, and in all cases the criterion of good lighting is that the illumination reaching the eye from the objects illuminated shall be over the hardest minimum noted.

Allowing for the effect of dark objects the lighting ordinarily given should amount to from 2 up to 5 or even 10 foot candles on the working surface. The figure last named is exceptional and only needed in extreme cases. Probably nine-tenths of the lighting practically needed would fall between the smaller limits given. Drafting rooms, tailoring shops and such like places where there is much fine detail or the work is very dark, from the exceptions. Natural light within doors covers a wider range of intensity. Near a bright window it may be 10 or 20 foot candles, while in the same room at the end away from the windows it may drop to less than one foot candle. The writer has found in his own office 10 foot candles on his desk and 0.5 foot candle on a table not more than 10 feet distant, at certain times of the day. With artificial light, one can very easily beat out natural light with respect to uniform distribution in almost any city building. But the variations of illumination in a naturally lighted room are uniform, while those in an artificially lighted room are apt to be erratic and sudden, so that the advantage of distribution with artificial sources is really badly needed. In one respect, too, natural light has an enormous advantage—it is secured at a very low intrinsic brilliancy. One gets, let us say, 10 foot candles on a desk, by the aggregate of the diffused light which streams in through perhaps 40 or 50 square feet of window. In artificial lighting he gets the same illumination from less than an equal number of square inches, even granting the use of diffusing globes. There is as yet no easy way of dodging this difficulty, although in considering the placing of lamps some useful methods of evasion will appear.

As to steadiness, the main question is not the actual magnitude of the changes in light. One could very easily endure changes of fifty per cent or more if they took place slowly, just as one works comfortably in the lessening light of the afternoon. Anything that approaches flickering is, however, extremely bad for the eye, and the fault of flickering, whether regular or irregular, is about the worst one which an artificial illuminant can have. Flickering, due to abnormally low frequency in incandescent lighting, is a case in point, fortunately rare since people have learned the unwisdom of trying it. The electric arc is subject to irregular fluctuations, fortunately neither frequent nor large in first-class modern lamps, but when such variations occur they may become troublesome, and it is hard to be too cautious in selecting carbons and overhauling the lamps for troubles in feeding. A thoroughly good arc lamp is not excelled in quality of light by any other illuminant, and deserves to be kept in perfect order. In direct lighting by arc lamps with diffusers has a very considerable advantage in steadiness over direct lighting, since the light at any working point is derived by diffusion from considerable areas, illuminated usually by several lamps, and no simple fluctuation, due to feeding or to shifting of the arc is likely to make a material change in the sum total of the illumination. Used directly, arcs are subject to very considerable variations of light at any one point, owing to the shifting of the arc around the carbons, a trouble especially vicious in enclosed arcs of small current, say, 3 or 4 amperes.

Aside from arcs there is very little trouble from unsteadiness on a well-ordered distributing system. Evidently a sudden fall or rise in voltage is objectionable, since the candle-power of an incandescent of ordinary voltage varies something like a candle-power per volt. The light will then change by, say, 10 per cent when the voltage varies about two per cent, and a variation of this magnitude taking place quickly is very annoying. It sometimes is produced by fluctuation of power on a motor or by hunting of synchronous apparatus and is extremely annoying. Starting up motors often causes a fall of several volts on a system that is a little short of copper, but this, annoying as it is, is less injurious than a much smaller fluctuation occurring periodically.

A periodic fluctuation of four or five per cent of the illumination is enough to be very distressing to the eye if it takes place two or three times per second; if it requires two or three seconds for its cycle it would hardly be noticed. It will thus be seen that as a practical matter steadiness to the requisite extent can be easily secured. Reasonable care in figuring the distributing system prevents its taking on any serious form with incandescent lamps, and with arcs care and judicious installation will secure good lighting.

Placing the lamps suitably is a more difficult matter. The fundamental rule to be followed is to so locate them that sources of high intrinsic brilliancy will not fall fairly within the field of view. Such too brilliant sources are all incandescent lamps even those with frosted bulbs, and all arcs without heavy diffusing globes of large dimensions. The frosted incandescents may be used sparingly if not where they are conspicuously visible, or where only seen casually. Clear bulb lamps should be used only when so high as to be out of the field of vision for ordinary work, or when screened by a diffusing shade or globe big enough or so shaped as to entirely conceal them. Even the widely used Holophane shades are too brilliant when used with clear bulb incandescent lamps to be left in the field of vision.

The eye is most tolerant of light having a general downward direction and the old rule that the light should come from over the left shoulder is a very safe one. The downward lighting insures the light striking the work at a moderate angle of incidence, so that the light diffused from it is considerable and the position over the left shoulder means that the light itself is out of sight and that for right-handed people at least the shadow of the hand is not upon the work. Shadows play an important

part in illumination. A light so completely diffused as to abolish shadows is rather trying to work by, and the extremely dense shadows given by small and brilliant lamps are almost equally bad.

A large diffuse source that gives perceptible but not obtrusive shadows is by all odds the most comfortable light by which to work. The old-fashioned student lamp, with a large porcelain shade, gave probably as comfortable a light as has ever been devised, albeit rather smelly and of only moderate power. Do not be afraid of cutting off light by diffusing shades, for a loss of say a third generally makes the remaining two-thirds more effective for good seeing than was the whole. Not only should bright lamps be kept out of view, but brilliantly illuminated patches should be avoided. Every one knows how troublesome is a little spot of brilliant sunlight on one's book, and how it tries the eyes. One can get the same effect of violent contrast with artificial light and should make every attempt to avoid it.

Desk lamps are most frequently troublesome in this way. If not actually in the field of vision they throw a most needlessly and often injuriously strong light in a bright patch, contrasting violently with the surroundings. When used they should be completely concealed in deep and wide shades (the 10-in. porcelain shade, white inside and green outside, is one of the best) and there should be plenty of general light on the desk to relieve the contrast.

Uniform distribution of light in offices and the like is important. If economy is a primary consideration a few general lamps in diffusing globes plus desk lamps where needed is the cheapest plan. If the very best illumination is desired the general lighting should be pushed high enough to enable one to read a newspaper comfortably pretty much all over the room, and additional local light rather sparingly if at all. Drafting and bookkeeping are the worst occupations for which to provide light, since they require a large amount over a considerable area. Bookkeepers have a bad way of using very finely ruled books and extremely fine pens with ink which is rather faint at first and turns black later Fine ruling may be necessary, but fine pens and pale ink are not, and books could advantageously be made of paper tinted enough to abolish brilliant white surface reflection.

One can hardly even outline the color question in a brief general paper. Lamps of any strong color are relatively ineffective for seeing purposes, the yellow being the most efficient part of the spectrum as regards its effect upon the eye in ordinary illumination. All ordinary lights save enclosed arcs are yellower than natural light and the enclosed arc is decidedly bluer. All sources of artificial light, therefore, need some modification if they are to show objects strictly in their natural colors.

An arc worked with a very pale buff diffusing surface probably gives the nearest approximation to daylight at present available. Incandescent lamps make yellow the whites; intensify the yellows and oranges and dull the blues. They also are apt to play curious pranks with certain blue-greens, greens, pinks and purples, and with the browns of similar character. There is no standard of white, even daylight varying greatly in hue. If one could see simultaneously the color effects produced by a clear sky and by the late afternoon sun the contrast would be something startling.

It is worthy noting that even the recent high-efficiency incandescent lamps—Nernst, tantalum, tungsten and so forth—are decidedly yellowish as compared with the arc, though much less so than ordinary incandescents. It should be remembered that in arranging illumination all dark colors "kill" the light, and all light colors tend to modify the illumination in their own direction. Hence, in lighting for true color values conspicuously tinted walls may quite upset one's calculations. When color tone is desired in the illumination, on the other hand, it can often be sufficiently given by the use of suitable wall tints. As a general rule lamps themselves strongly colored should be avoided save for purely decorative purposes.

Cooking by Electricity.

BY PUTNAM A. BATES.

THE use of electrical energy for the direct production of heat for various purposes dates back to the early days when the electric motor was first making itself felt as a factor for our commercial enterprises.

Many of these early productions were naturally very crude and unreliable and unlike the electric motor which, in spite of its early defects, filled a growing need as nothing else could, they were unable to cope successfully with the competition of heating and cooking apparatus using gas or coal. The high cost of electrical energy in the early days also militated strongly against the use of electricity for heating purposes.

For these reasons the public received an unfavorable impression as to the value of these electrical devices and manufacturers did not give the subject the attention which it deserved.

Within the last eight or ten years, however, there has been a very marked development and improvement in the manufacture of electrical heating apparatus of all kinds. This is perhaps particularly the case with appliances for cooking.

The result of this activity among the manufacturers of this class of apparatus is that we to-day have an assortment of electrically heated cooking utensils and apparatus available at reasonable prices which, from the standpoint of reliability and suitability, are fully the equals of apparatus using any of the older methods of heating, and in point of efficiency the electric are so far superior to the others as to put them in a class entirely by themselves.

Another very great advantage of the electrically-heated apparatus which is frequently lost sight of by the average person is the comparative freedom from fire risk attendant upon its use as compared with those deriving their heat from a fire or gas flame. In fact, the very stress, which those interested in the perfection of electrical apparatus of every kind, have laid upon the removal of all fire risks from the use of the electric current, has in a measure caused the public to regard it as exceptionally hazardous in this respect.

While the writer is confident that those most interested would not care to see this stress abated one iota, he cannot help feeling that it has caused the public to magnify the dangers arising from the use of the electric current and to disregard much greater dangers arising from other causes.

How often we see or learn of serious fires arising from overheated furnaces or kitchen ranges, defective or dirty chimney flues or from an explosion of gas which has accumulated due to some one opening the valve and forgetting to apply the match until too late! Compared with this the danger of fire arising from a properly installed system of electric wiring is nearly or quite nil.

The cost of cooking by electricity depends, of course, upon the cost of the electrical energy to the consumer. Many, however, are satisfied to dismiss the question of cooking by electricity from their minds with the thought or statement that it would be impossible for electricity, generated, as in most cases it is, from the energy stored in the coal, through the round about means of the steam boiler, steam engine, dynamo and transmission wires, to compete upon a cost basis, with the direct use of coal for cooking purposes.

Those who argue upon this basis lose sight of the great advance which has been made by gas, also a product of coal, in this field where it very frequently is able to show a decided saving as compared with the direct use of coal for the same purposes.

The reason for this is found in the efficiency which may be obtained in the use of these various sources of heat.

While the cost of one heat unit delivered in the form of artificial gas must, of necessity, be considerably greater than that of an equivalent amount of energy delivered as coal, the greater saving brought about by the more direct application of the heat possible with the gas flame, and the possibility of entirely shutting off the supply of gas at all times when heat

is not needed, in many cases enables the gas-heated apparatus to show a saving in cost of fuel when compared with those deriving their heat from the direct consumption of the coal.

The same is true with the use of electrical energy, only to an even greater degree.

The ease with which the electric current may be switched on or off and controlled is even greater than that pertaining to the use of gas as a source of heat and the efficiency of heat transmission to the body to be heated is far greater. The efficiency of heat transmission with the ordinary gas range is placed by those who have made a study of this subject at about fifteen per cent, while the various high grade electrical cooking devices now obtainable show an average efficiency of heat transmission of about seventy per cent or better.

It is, however, a fact that electricity cannot compete successfully upon the basis of cost alone with gas or coal for cooking purposes at the rates ordinarily prevailing throughout our residential districts.

Electric lighting companies generally are only just beginning to realize the possibilities in this line and to make systematic efforts to obtain this class of business.

It would seem that this class of load, coming as it generally would at a time when the station load is small and seldom if ever overlapping the peak load, would be particularly desirable as it would add to the day and summer load without necessitating any additional investment in copper or power plant apparatus. In order to obtain any great amount of it, however, it would be necessary for the lighting companies to make a special rate for energy used for this purpose, which to compete with gas at one dollar to one dollar and a quarter per thousand should not exceed three cents per kilowatt-hour.

This is a low rate, but any considerable quantity of this desirable class of business cannot be obtained at higher rates, and under the circumstances even this rate should show a reasonable profit for the lighting company.

This would seem evident when it is remembered that one of the chief reasons why it is necessary to charge the small residential consumer so high a rate for his energy is because his monthly bill is so small a percentage of the cost of power plant apparatus and line-wire which must be installed and maintained in order to supply his demands. If, then, his monthly consumption can be increased some three or four times without necessitating any increased expenditure for apparatus and line-wire, would it not be good policy to increase the output and revenue of the plant by giving the customer the advantage gained by the lighting company due to the increased load factor?

But even at somewhat greater cost of operation, electric cooking has many advantages which appeal to those who can afford to pay for them, just as there is in the field of artificial lighting.

If the electric light had no other argument to offer in favor of its use than its cost as compared with other forms of illuminants its progress would have been slow. In spite of this, however, it has come and is rapidly crowding all other forms out of the field. The reason for this is to be found in its many inherent advantages which have in most cases outweighed the higher cost of operation which is usually found to prevail when compared with other forms of artificial light.

The same is true of electrical cooking.

The rapidity with which food may be cooked by the use of electricity, the uniformity of temperature obtained which makes cooking by the clock a possibility, the great comfort and convenience, the cleanliness and freedom from smoke and smell incident to this method of cooking make it ideal for all places where these advantages are of importance.

It would seem almost unnecessary to advance any arguments in substantiation of these claims for electric cooking methods, but just a word for the benefit of those who have not had the advantage of personal experience with the operation of this class of apparatus.

It is a fact that cooking by electricity can be accomplished in less time than by other methods. This is partly due to the possibility of applying the heat just where it is needed and partly to the fact that, in some forms at least, cooking may be carried on from all sides simultaneously.

The absolute uniformity of temperature removes the science of cooking from one of guesswork requiring careful watching to one which may be regulated entirely by the clock. In this way uniformity of results may be obtained even by the comparatively inexperienced.

The high efficiency of operation and the absence of an oxygen consuming fire result in cool and comfortable operation, and the possibility of locating the cooking apparatus upon a table or other convenient place adds greatly to the convenience of cooking by this method.

The absence of all coal, ashes and escaping gas or smoke rising from the fire or from burning grease make this the cleanest possible method of preparing food for the table.

As might be expected from what has just been said, the results obtained with this method of cooking are beyond all comparison with what can be obtained with any of the older methods.

A chop or steak, for instance,. cooked in an electric broiler will be evenly done throughout, absolutely free from all gas or odor other than that of the meat itself and full of the natural juices of the meat. Compare this result with a similar cut cooked over a fire, overdone on the surface, underdone in the center,. charred in spots by the fire or burning grease as it often is, with most of the juice of the meat lost and often with a decided taste and odor of the fire.

Electrical cooking apparatus is adaptable to use anywhere where electric energy may be obtained at favorable prices. There are, however, two fields in which its use should be particularly advantageous: These are, in the small kitchen where the mistress of the house does most or all of the cooking and the hotels and restaurants where the patrons are willing to pay for having everything of the best obtainable and where rapid cooking is an important object.

The kitchens of households whose work is all in the hands of servants is not included for the reason that in such, economy is not the rule, and unless the parties interested are able and willing to pay for the added luxury the other advantages become of lesser importance and would not be sufficient to outweigh the greater cost.

The small apartment supplied with hot water and steam heat from a central source, offers a very attractive field for electric cooking. In many of these apartments the mistress does the cooking, and even where this is not the case it is usually possible for her to so watch operations in the kitchen that economy in the use of electric energy will result.

There are many electric cooking devices upon the market which are especially suited to just this condition, and the small amount of space which they require together with the many other advantages which they possess in common with the others and which have already been mentioned, make them particularly desirable for use where rooms are small and where it is nearly or not quite impossible to confine any smoke, odor, or heat which may be produced in the kitchen, to that room.

In addition to the cooking utensils required in the kitchen, electricity may be used in the dining room to great advantage in a coffee pot, tea kettle or chafing-dish. It will be found that any of these may be operated with economy, as compared with the cost of using alcohol, even with current at the prevailing rates for lighting, and in addition the frequent and annoying destruction of cherished centre pieces and doilies, not to mention the polish of the table, which so often results from the use of an alcohol lamp, will be entirely eliminated.

Perhaps the largest and most promising field, for the present at least, for the introduction of electric cooking apparatus and methods is in the first class hotels, restaurants and club houses. Here the many advantages are sufficient to outweigh the single consideration of cost of energy even where a low rate cannot be obtained.

This is apparent from a consideration of the prices received in such places, from which it is evident that the actual cost of the fuel or other energy expended in the preparation of any article of food is a very small percentage of the charge for the service.

To meet the conditions prevailing in these places successfully requires a very different form of apparatus than is

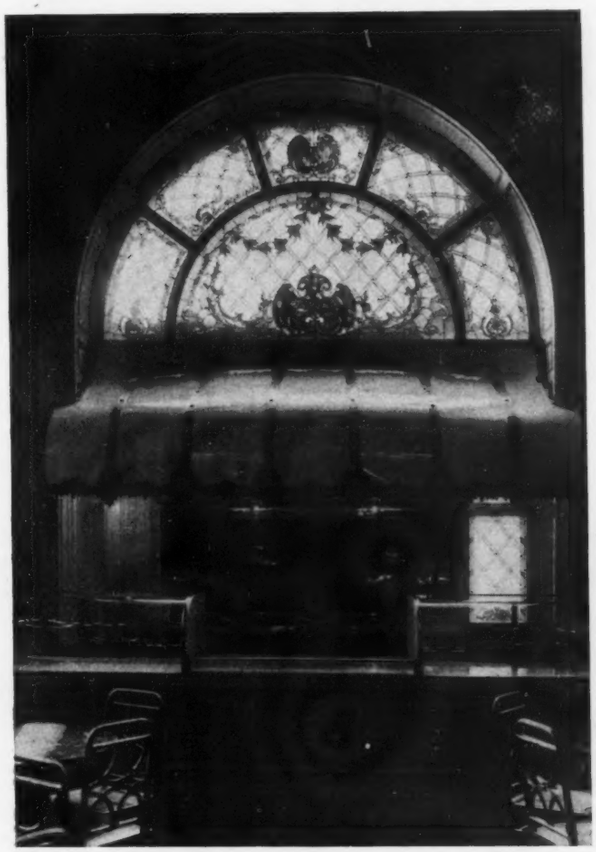


FIG. 1.—ELECTRIC GRILL, WALDORF-ASTORIA HOTEL.

needed in the private kitchen. The apparatus must develop to the fullest possible extent all of the advantages offered by the us of electricity for cooking. It must not only produce superior results, but it must also do its work in the shortest possible time, with as little loss of heat into the room as may be, and all odors of cooking, even those of the food itself must be entirely eliminated. In addition it must be absolutely reliable in its operation and so constructed that it may be easily and quickly repaired by the average mechanic, when partly worn out.

The electric grill shown in the illustration is one embodying these features to a very considerable extent, and so successful has it been in its operation that the room in which it is installed is much the best patronized room of its character in the hotel. The reason for this is to be found in the superior quality of the cooking and in the rapidity with which orders may be filled.

This grill is made up on the unit principle, each compartment being entirely distinct and self-contained.

These compartments are completely closed except for a flue at the back, the purpose of which is to carry off all odors, and is so insulated as to allow but very little heat to escape into the room.

Within these compartments the heating coils are arranged in such manner that the heat produced will be most effectively applied to the article to be cooked.

Each compartment is equipped with a water pan for collecting any grease which may drop during the process of cooking.

All electrical connections are made in a solid and permanent manner at the back of the grill in a space provided for that purpose, and the current supply to each unit is controlled by a separate switch.

The energy consumption of each of these units or compartments is at the rate of approximately three kilowatts. As, however, an application of the current for four or five minutes is sufficient for cooking a dozen French lamb chops, or from ten to twelve minutes for an extra large steak, it is apparent, not only that the cost of this electricity, even at so high a rate for energy as ten cents per kilowatt-hour, would not add materially to the cost of the meat, but also that the time required for preparing the meat for the table and during which the table is being occupied to the exclusion of other patrons, is very much less than would be required for the same operation with coal, charcoal or gas as the source of heat.

The results obtained from this grill are particularly good in that when the meat is inserted in the broiler, heat is immediately applied to all sides, thus closing the tissues of the meat and preventing the escape of any of its juices.

So great and varied are the advantages offered by the use of electrical energy for cooking that it would seem as if but a few years, at most, must see the abandonment of all other

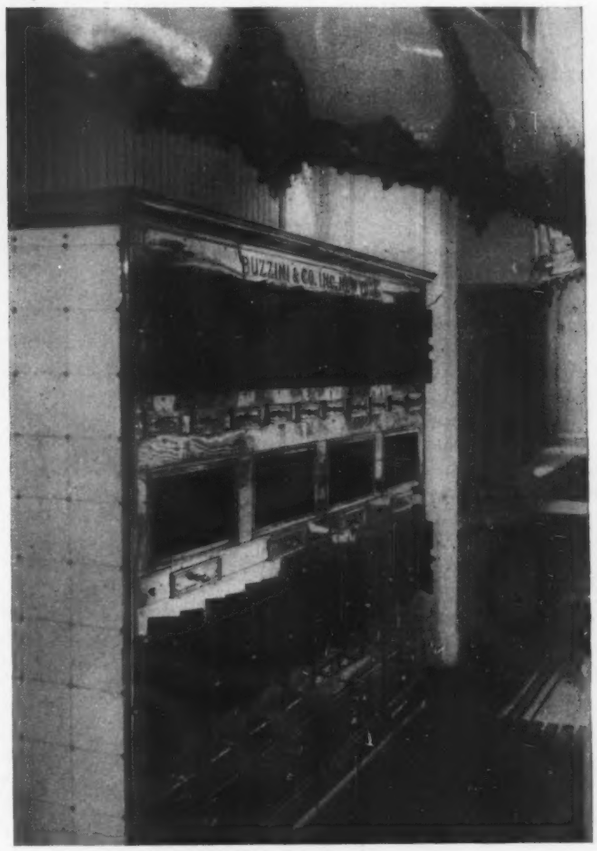


FIG. 2.—ELECTRIC GRILL COMPARTMENTS.

forms of cooking apparatus in places of the character just considered, and the substitution of those operating with electric energy. The rapidity with which this takes place, however, depends largely upon the amount of encouragement offered by the electric lighting companies in the way of favorable rates for energy supplied for this purpose.

Electric Heating.

By W. J. Barr.

Nothing has appeared before the public during the past 50 years that has excited so much interest, nothing has received so much welcome as the electrical heating appliances placed on the market during the past year.

It is not my intention to write of the evolution of electric heating but to show if possible how rapidly this odorless and cleanly form of heat is coming into general use: the awakening of the people to its wonderful conveniences when applied to articles devised to save the labor and the drudgery attending the cooking and the heating for the household. What it has taken to bring this keen interest; the time that has been given by able men to surmount difficulties, time measured with lives not by hours; the sacrifices men have made of private fortune to encourage men who had only brains and their labor to give to the work of perfecting; the courage manifested through all the preparatory stages; the capital (that never paid a dividend) organized to launch into commerce devices that are ultimately destined to prove the greatest boon to the household of modern times is truly commendable, but if not more marvellous certainly more interesting is the awakening of the consumer of electric energy to the consciousness that there is within reach perfect appliances designed so simply and inexpensively as to make it possible for any one to install them into even modest homes, and render more tolerable the labor entailed in smoothing clothes, and preparing meals and even to dispense with entirely the labor of making and maintaining fires.

No longer is gas—artificial or natural—a competitor. Slowly perhaps, but nevertheless surely are we pushing that vitiating substance out of the home, which we desire at least to be healthful and turning it underneath the factory or central station boiler to be used as an agency to generate steam to move the engines that in turn gives us the electric current which is becoming more and more appreciated as we find new uses for it.

To-day millions of dollars are being spent to dam the waters capable of developing power. Plants are being constructed at the coal mines not to generate steam, not so much for the manufacture of gas, but more for the generation of electricity to be conducted to points of consumption within a radius of more than two hundred miles. All this for the reason that at last electricity has become established as the standard of illumination and the climax of perfection in the methods of producing heat.

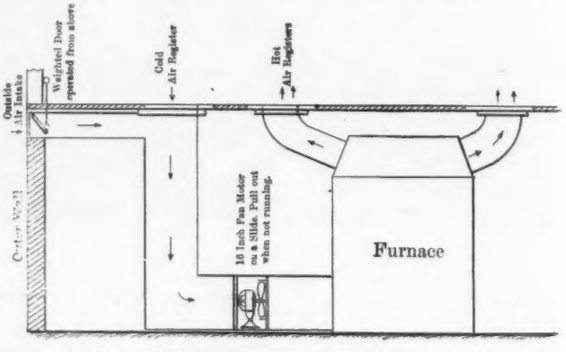
The progress of electric heating is no longer held back through prejudices. During the past 12 months so many men, just and impartial in their examination, have found that electric heating conspicuously surpasses all other forms in efficiency and convenience, and their word together with the recommendation of central station men and the electrical dealers, has stood out so predominantly as to influence the purchases of electric heating appliances to the amount of between $500,000 and $600,000 in one year. Apartment houses are being constructed with kitchens designed for electric cooking only, with regulations permitting no other method. The dining-room in the electric home is equipped with chafing dish and coffee percolator in addition to the complete outfit in the kitchen for cooking food. People are buying electric air radiators for heating the rooms when it is not exigent to start their furnaces and many have discarded the furnace heat altogether. Electrically-heated carpets and rugs have found favor in that they distribute the heat uniformly over the surface of the floor, keeping the feet warm and the head cool. The electrotherm has finally substituted the heavy and inefficient hot water bag in the hospital and home. The thermophile bed-covering for sleeping in cold rooms has proved the acme of hygiene. Thousands of ladies are enjoying the convenient and cleanly appliances for heating their curling irons, and mothers are appreciatin the new baby milk warmers and the electric heating bath, and the one million electric smoothing irons in use to-day is reducing the labor of ironing to a minimum, and at a cost not exceeding the old methods. So electric heating is fairly launched, not as a luxury for the rich, such as the present automobile, but as a necessity in the homes of men receiving even small salaries, because it furnishes the only method for healthful and cleanly cooking, abolishing drudgery and inconveniences of the home work and even alleviating bodily pain.

The people have been slow, it is true, to appreciate all this, but that they are now realizing these benefits is evidenced by the fact that there are towns where so many electric irons have been bought during the past year so as to make one in use for every nine persons. For the present this is impossible to duplicate in most towns, but it will not be for long for it is inevitable that every house must be wired wherein lives the thoughtful American, equipping him with the most potent factor for the comforts and enjoyment of modern life.

The Fan and the Furnace.

By J. R. Cravath.

About the time the article "Another Opportunity for Day Load," by Mr. F. N. Jewett, appeared in the Electrical World for Dec. 1, 1906, in which he showed the application of an ordinary 16-in. fan motor to the hastening of circulation in a hot-air furnace, the writer installed a similar arrangement in his house. As a result of a few weeks' trial of this, I can say that Mr. Jewett does not in the least overstate the advantages derived from this scheme. Although comparative tests on a matter of this kind are difficult, as near as we can tell it takes


Outside Air Intake
Weighted Door operated from above
Cold Air Register
Hot Air Registers
16 Inch Fan Motor on a Slide. Pull out when not running.
Furnace

BEST ARRANGEMENT OF FAN AND FURNACE.

about half the time to raise the house temperature to 70 degrees in the morning with the fan that it did without the fan. Since it is not necessary to let the furnace fire go at full heat as long each morning as before the fan was used, it is reasonable to suppose that considerable coal is being saved because it is in the morning when the house temperature is being raised rapidly that the heavy drain on the coal pile comes. Even if it did not save any fuel, it is worth all it costs as a comfort and convenience. The fan is especially valuable in making it possible to heat quickly rooms which before were difficult to heat.

The explanation of the greatly improved results to be got from a hot-air furnace with forced circulation of this kind is of course as Mr. Jewett states, that natural circulation is not depended upon. In connection with this scheme it might at first be thought that it would make little difference whether the furnace delivered a certain number of cubic feet of air per minute at a temperature of 40 degrees above that of the house or whether it delivered half that amount of air at a temperature of 80 degrees above that of the house, or, in other words, it might be supposed that a change in the velocity of the air through the furnace would simply reduce the temperature of the discharge and increase the volume of air flowing so that

the total result in heat units delivered upstairs would be the same. The defect in this theory is that the loss by radiation into the basement from the outer casing of the furnace increases as the temperature of the air passing through the furnace increases. The same is true of all the hot air pipes leading from the furnace. Besides this, the forcing of circulation by the fan creates better circulation within the rooms themselves and tends to get the warm air into all parts of a room more rapidly.

However, it is not necessary to theorize about the matter, as the advantages of the fan arrangement are so apparent to any furnace owner who will try them that there is no room for further argument. I have before me a letter from the president of a large furnace manufacturing company in which he states that his company expects to make extensive use of electric fans in connection with its furnaces in the future.

I believe that the arrangement of fan furnace and cold air intakes usually to be preferred when conditions will permit is to put the fan as indicated in the accompanying sketch. The efficacy of the fan would not then be lost should it be desired to take in some air from outdoors when running the fan or if the outdoor intake should be unintentionally left open. The arrangement shows a furnace which is provided with both an inside and an outside cold air intake, as is the one shown by Mr. Jewett, but the fan motor is placed between the point where these two intakes join and the furnace.

The fan motor should be mounted on a slide so that it can be withdrawn from the cold air duct when not in use and the air passage will not be obstructed. This slide should have a wood or sheet iron partition with a hole in it just the size of the fan so that eddy return currents of air cannot form and reduce the fan's efficiency.

Special Arc Lighting on Peoria Business Streets.

The Peoria Gas & Electric Company has begun a movement to get the down-town merchants to put in special arc lamps along the curb line on neat goose-neck iron posts. So far one installation of ten of these lamps has been put on one of the principal streets. These lamps, which are spaced 26 ft. 7 in., are 6-amp., alternating-current, constant-potential arc lamps turned on and off by the company and operated until 10 p.m. every night except Sunday. On Saturday they are lighted until 11 p.m. A rate is charged which nets the company about 8 cents per kw-hour. Several large stores in Peoria have been induced to outline their buildings with incandescent lamps. This decorative lighting brings in about 5 cents per kw-hour, being done on a flat rate, and turned on and off by the company.

A Small New Zealand Central Station.

BY HORACE PRIESTLEY.

In a recent issue I noticed the question, How small a town will justify the building of an electric plant? I think New Zealand can claim to have one of the smallest towns in the world running a central station, namely, the Borough of Patea, with a population of 800. We have a 3,000-volt, 50-cycle, single-phase alternator, with a normal output of 45 kilovolt-amperes, driven by a 67-hp water turbine at 750 revolutions per minute. The alternator is of the Brown, Boveri, "D" type, and the turbine was built by the Atelier Company.

There are four miles of transmission line, and about 20 miles of insulated primary and secondary wire. The secondary distribution is at 100 volts. The business part of the town is supplied by a 25-kw transformer made by the General Electric Company. The residences, being scattered, are supplied by small transformers of the "Peerless" type. There are 40 32-cp street lamps, and one G.-I. arc lamp. The Corporation pays $750 a year for these lamps, running from sunset to 1 a.m. In all there are 96 customers, all for light. Only two persons are employed, an engineer and a cadet.

The revenue for the last year was $3,400 and the expenditure was $2,940. Allowing $250 for depreciation, leaves a profit of $250. The expenses were made up as follows: Wages, $1,250; interest on capital, $1,000; repairs, $650. The prices charged for electricity are, up to 20 kw-hours, 20 cents per kw-hour with 25 per cent discount if paid before the 10th of the succeeding month. Above 20 kw-hours the rate is 11 cents per kw-hour. Formerly some service was on a flat rate, but at present all is on meter. It is not all play running such a plant, without any reserve equipment. As an instance, I had a 3-kw transformer burn out, and the only material on hand was a pair of 5-kw coils. As these were too large for the 3-kw case and core, I made a case out of galvanized iron; a sheet of black charcoal iron was annealed, cut into strips and made into a core, which was stuck into the 5-kw coils. The case was filled with oil, the transformer put at once into work, and it went along all right for six months until we got a new one. Of course, I could not guarantee the core loss, but it helped us out of a hole. Small plants if judiciously managed will pay.

Electric Trucks for Lighting Companies.

The General Vehicle Company, of Long Island City, builder of electric automobiles, has just turned out of its shops two excellent types of electric trucks intended for strictly electrical

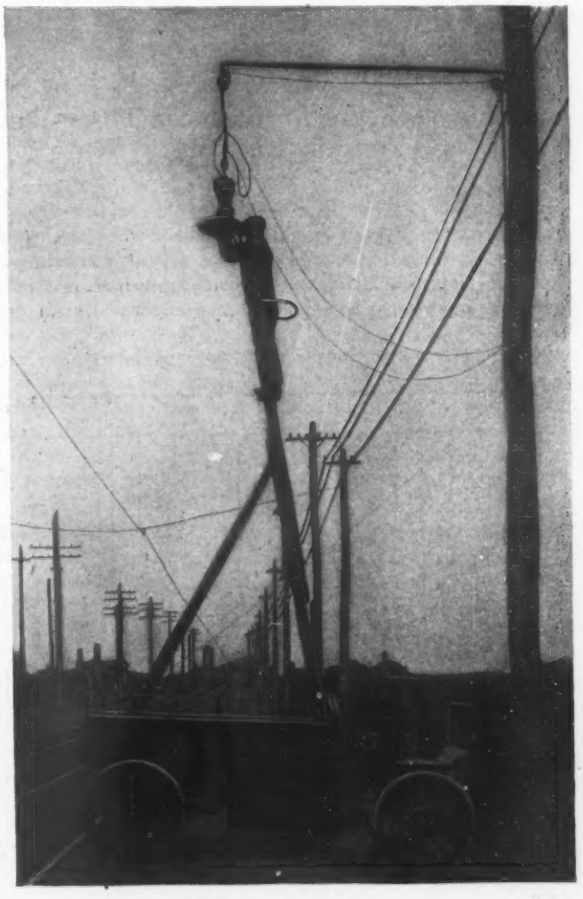


FIG. 1.—LADDER WAGON.

purposes. They are shown herewith in Figs. 1 and 2. The platform truck was built for the Commonwealth Electric Co., of Chicago, Ill., and is used for hauling and drawing cable. This truck, which has a carrying capacity of five tons, is

equipped with an electric hoist, used to lift the cable on the truck, deposit it on the street, and draw it through the conduits. Thus 280 feet of cable can be drawn in from five to ten minutes, work which before usually required six or eight men at least thirty minutes.

The ladder wagon was built for the Narragansett Electric Lighting Co., of Providence. This, it will be observed, enables

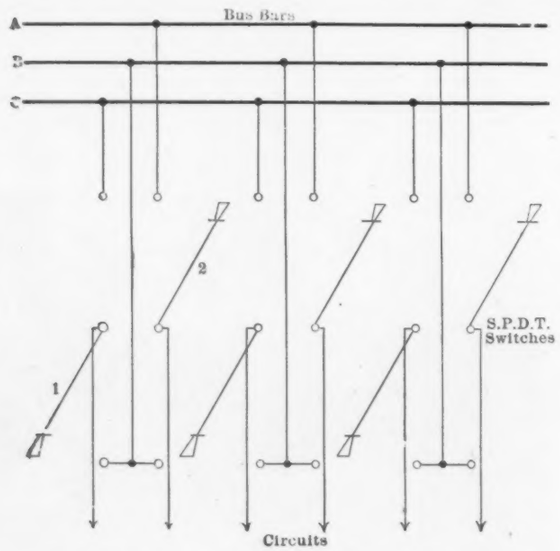
FIG. 2.—PLATFORM TRUCK.

one man to do lamp, wire and trolley work, which formerly required two men, as it was necessary to have one man for the horse, while the other man was on the ladder. This machine is speeded up to 10 miles an hour, and has ample battery capacity for 35 to 40 miles, and a carrying capacity of 2,000 lbs.

Switching Scheme for Balanced Three-Phase Low-Tension Lighting System.

By John Allen Corcoran.

The problem of keeping a low-voltage, three-phase system balanced on a lighting load is usually a difficult matter, due to the fact that the individual lamps are turned on and off at irregular intervals. The following scheme permits great flexi-



SWITCHING SCHEME FOR BALANCED THREE-PHASE, LOW-TENSION LIGHTING SYSTEM.

bility of control at the switchboard, allowing each circuit to be readily thrown on any phase.

The scheme is to use single-pole, double-throw switches, as shown in the accompanying diagram. The ordinary method is to use double-pole, double-throw switches, connecting the middle legs to the circuits and the top and bottom legs each to one phase. This method allows the load to be taken from either of two phases only, by each switch, while with single-pole, double-throw switches connected as indicated, it will be seen that it is possible with the two required for each circuit, to throw that circuit on either of the three phases of the machine. For instance, with switches 1 and 2, phase AB may be used by throwing switch 2 on the upper terminal and switch 1 on the lower terminal. Phase BC may be used by throwing switch 1 on the upper terminal and switch 2 on the lower terminal, while phase AC may be used by throwing both 1 and 2 on the upper terminals. It will be seen that no short-circuit could be caused nor any harm done by using the only other possible combination, namely, throwing both switches on the lower terminals.

Street Lighting at La Grange, Ill.

The North Shore Electric Company, which furnishes electric lighting service at the suburban village of La Grange, Ill., has been recently overhauling the electric lighting system of that town and among other changes, has substituted the new high efficiency incandescent street lamp for the old low efficiency lamp. Another interesting feature of the new street lighting system is the use of small G. I. constant-current transformers working on the same principle as the General Electric constant-current tub transformers used for arc circuits. These small constant-current transformers are, of course, entirely automatic and do away with the old system of cutting in lamps at the station when lamps burn out on the street lighting circuit. The new street lighting circuits are 1.75 amp. and the lamps used are rated at 20 cp, 2.7 watts per candle, taking 54 watts each at about 30 volts. The former street lamps of the same candle-power took 80 watts each. There are three circuits, each circuit having its own constant-current transformer of 8.8-kw capacity, the primary voltage being 2,200 and the maximum secondary voltage about 5,000 at 1.75 amperes. A lamp socket is used containing a film cut-out, the insulation of the paper film being punctured by the voltage when the lamp connected in shunt with it burns out. This is the same principle as used in the film cut-outs employed for many years in series street lighting. Two lamps are placed per block, one at street intersections and one midway between streets. The blocks are 750 ft. long by 350 ft. wide, center to center. This undoubtedly gives better illumination on shady residence streets than an arc lamp placed every two blocks, as there is less blinding glare and fewer deep shadows.

Modern Switchboard Devices.

A paper read before the New York Electrical Society by Mr. C. W. Stone contained much information concerning modern practice in the design of switchboards. The author stated that the oil switches of to-day are very necessary in high-tension systems for the distribution of energy, and to them is to be attributed the successful operation of such systems. The opening of an arc in the air on an alternating-current system is apt to result in dangerous rises in voltage, by causing surges in the system. Indications tend to show that an oil switch opens on the low point of the wave, or practically at zero current, and for this reason it has a tremendous advantage over any switch opening in the air.

A view of a switch, which may be considered as an example of present oil switches for moderate capacities, is given in Fig. 1. The operating mechanism and the contacts and the contact rods, etc., are located on a top casting. The contact rods which pass through the casting are surrounded by porcelain insulators. These contacts are enclosed in an outside tank, which is filled with oil, barriers being placed between the different poles. Contact yokes are carried on the end of wooden rods, which are attached to the operating mechanism. The movement of the handle raises or lowers the yokes, bringing them when raised into connection with the contact blocks.

For very large loads a totally different design of switch is used, as shown in Fig. 2. Each pole of the switch is made up of two cylindrical oil vessels, the bottom of which contains a contact. The oil vessels are mounted on large insulators placed in the base of a switch compartment. The two elements of each phase are separated from the other phases by means of brick or soapstone barriers. Passing through the top of the two oil vessels of each phase are two contact rods which are placed on a yoke. The yoke is fastened to the operating mechanism by means of a long wooden rod. The connections to and from this switch are made to studs passing through the insulators which support the oil vessels. The operation of this switch is exactly opposite to the one described above, as in this case the contact rods are pulled up from the contacts, while in the other type of switch the contact rods are dropped away from the contacts. The operating mechanism may be driven by compressed air or electricity. With the electrically-operated switch, the tripping is entirely independent of the motor, as the action of the switch is such that the motor carries the crank of the mechanism slightly past the center, where it is held in position by a small toggle, which is opened by means of a small electric magnet. Many improvements have been made in the small details of this type of switch since it has been in use. One of the latest and best improvements is in making the oil vessels

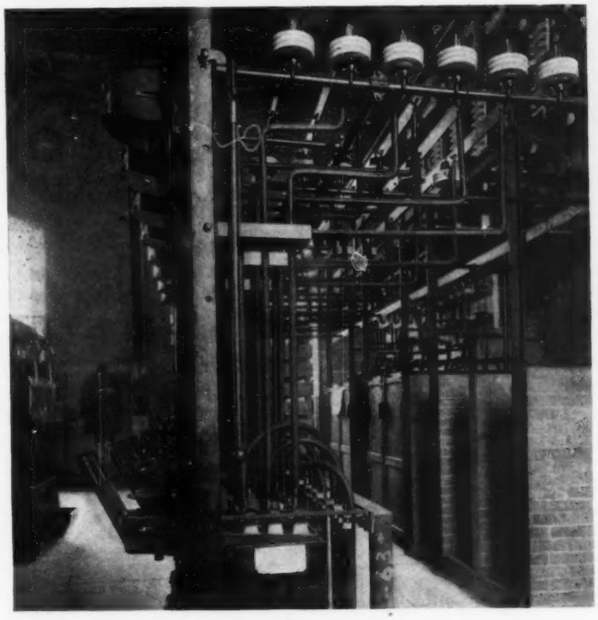


FIG. 1.—SWITCHBOARD, CALUMET AND HECLA MINE.

of pressed steel. The original vessel was made of a seamless brass pipe. In the bottom of this pipe a bottom carrying the contact was soldered, and the top was threaded to receive the cap. The new type of vessel is made of steel, the top being put on in the same way as on the brass pipe.

Oil switches of the type just described are in successful use for e.m.f's as high as 60,000 volts. In the 60,000-volt switches, such as shown in Fig. 2, the oil pots instead of being of metal are made of wooden staves somewhat like a barrel, held together by wrappings of cord. The pots are mounted on insulating standards.

For alternating-current work a number of different types of relays are in use; the overload relay which has been generally used consisting of a simple solenoid and a set of contacts, so arranged that the movement of the plunger in the solenoid will properly operate certain contact mechanisms. The relays are made both for instantaneous operation and with time limit arrangements. An excellent type of time limit arrangement consists of a simple bellows placed above the contacts and fastened to the plunger (see Fig. 3). This bellows is provided with a small valve at the top, the opening of which can be adjusted so that the relay can be set for any desired time. With a relay of this type the time element is dependent upon the amount of current flowing through the solenoid, and is practically directly proportionate to this current. Thus if set for a certain time with a certain current, if the current is

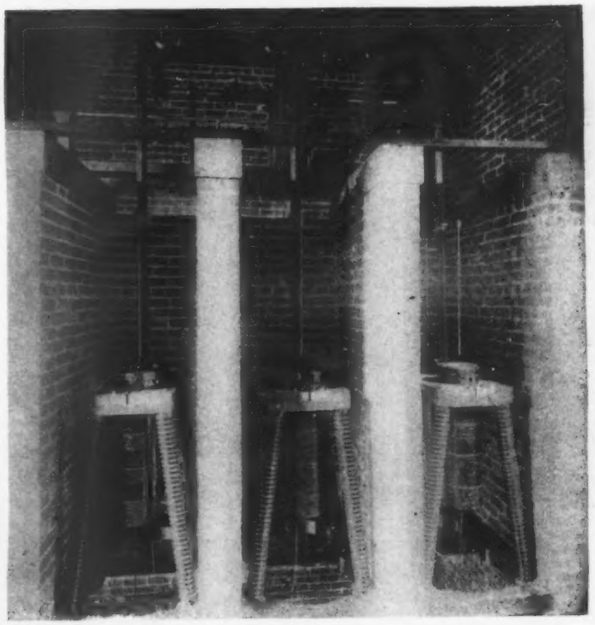


FIG. 2.—60,000-VOLT OIL SWITCH, WASHINGTON WATER POWER CO., SPOKANE, WASH.

double, the relay will open in practically half the time, and in cases of short-circuit it becomes practically instantaneous.

Another type of time limit relay is the definite type which is made in two ways. One is the bellows type, which is very similar to the inverse time element type, the only difference being that the plunger is not rigidly connected to the bellows, but has a spring interposed in such a manner as to make the pressure on the bellows constant whenever the relay operates. The other form is a clock-work mechanism, which consists simply of an ordinary clock mechanism which revolves a fan, the blades of which can be adjusted so as to require a predetermined time of operation; the clock mechanism is released by a simple electromagnet connected to the series transformers in the circuit.

Alternating-current switchboards for medium voltages and

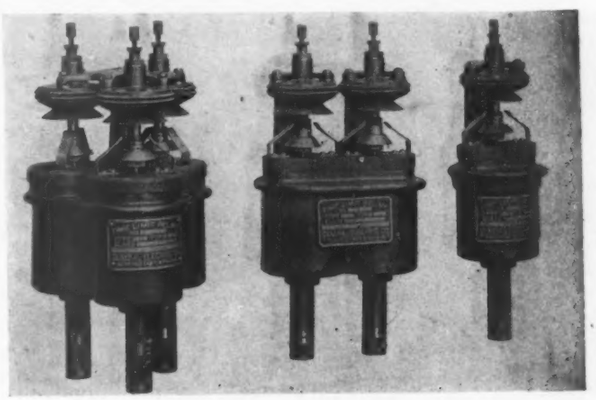


FIG. 3.—BELLOWS TYPE TIME-LIMIT RELAYS.

for medium capacity stations should have the buses mounted at the top and in back of the board, or in some cases beneath the floor, and the oil switches mounted directly on the panel or preferably on a pipe framework at a considerable distance back of the panels. As the potential increases and the capacity of

stations increase, extraordinary precautions must be taken to prevent any trouble, and to confine any trouble. Switches should be mounted in brick compartments, and at 10,000 volts or above, the switches should be made up of single-pole elements, and each pole kept in a separate compartment. The bus-bars should also be placed in brick or concrete compartments, keeping each phase separate from the others (see Fig. 4).

The author expressed the opinion that in the majority of cases

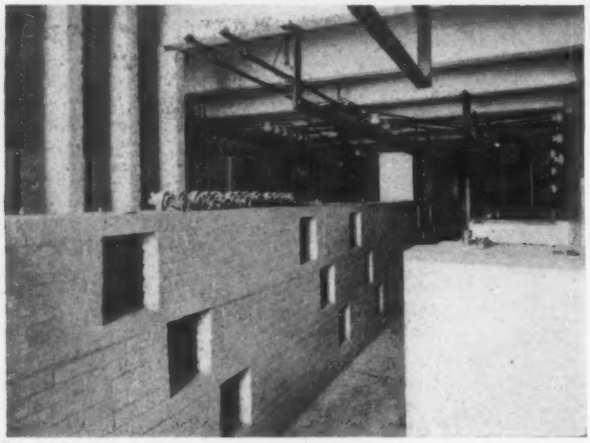


FIG. 4.—BUS-BAR COMPARTMENTS, LIGHTING END, NEW DOCK STREET SUB-STATION.

it will be found that all things considered it will be best not to locate the board at the end of the building, but rather along the wall opposite the boiler room, avoiding galleries as much as possible. Many galleries always mean long and expensive runs of cable and controlling circuits, and in consequence increases the chances of trouble. If the feeders go out below, the switches can be placed on the main floor and the bus-bars and compartments placed in the basement. If it is not possible to get the buses in the basement, it is possible to build one gallery for the switches, and place the buses on the main floor. A number of stations have been built recently with all of the switching de-

FIG. 5.—REMOTE-CONTROL SWITCHBOARD AT NECAXA, MEXICO.

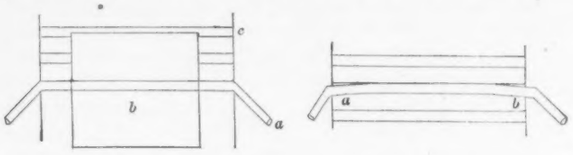
vices in a separate house. This method has numerous advantages. The switchboard men are not disturbed by any unusual sounds and trouble in the engine room, such as a broken steam main, would not cause them to become confused and make wrong moves. All the necessary orders can be transmitted, either by signal devices or by telephone. A separate switch house of course is not desirable, except in very large stations.

Armature Notes.

By Arthur B. Weeks.

In winding and taping an armature, it is sometimes necessary to force the tape through a small space; it is not, however, advisable to cut the tape into short pieces. Every one knows how difficult it is to work, because of its sticking and balling up. This trouble can, however, be prevented by rubbing the tape with paraffine.

When you have bought armature coils which prove too tacky, dip in soapstone, or rub over with a stick of paraffine. This will prevent damaging the coils; otherwise the wires of the coil will invariably cross or bunch up, after which no amount of



FIGS. 1 AND 2.—SLIPPING ARMATURE COILS INTO PLACE.

hammering will get the coil in place again; and even if it did, the chances are that a short circuit would follow in a very brief time. The writer has seen much work of this sort attempted.

Again, when a coil fits too tightly in an armature slot, because of too much slot insulation—especially if it is a long coil and the right tools are not used to enter the coil—while the center enters, both ends are apt to back just enough to cause a great deal of trouble. Hammering often spreads the wire, spoiling the coil entirely. Had a wider piece of fibre been used to force the coil over, it would have been better. Of course it is best to get the necessary insulation in the slot, but look to getting the coil in place without damaging it. Fig. 1 illustrates the idea to be conveyed. It is intended to slip coil *a* forward into slot *c*. Place the piece of fibre ¼ in. thick under the coil and into slot *c;* if the coil fits too snugly at the sides, or if the fibre is too narrow, the coil will take on the condition shown in Fig. 2. Then too often the coil is hammered at *a* and *b* to drive it into place. If this were done with but a slight blow, it would not so much matter; but often a succession of severe blows is struck. Every armature has to have a certain amount of hammering, in the general course of events; it is a pity that it should receive any that is not needed, especially when there is an easier way, as has been shown.

Armature shafts are often placed on iron rollers while winding, when the armature must be held with one hand, while the other hand pulls or pushes in the coils. It is a good plan to have a friction band operated by foot power, enabling one to use his hands freely. A helper is too expnsive for such simple work, and the friction band can be easily worked out by any winder. With both hands free, two pieces of fibre board can be used to force a coil forward when they are very tight, as shown in Fig. 3. Do not use an old file and hammer the coils in place into the slots after they are once entered; it is too

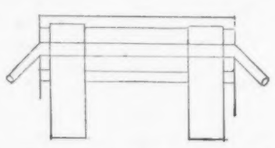


FIG. 3.—FORCING ARMATURE COIL FORWARD.

risky, and will give some coil maker a bad reputation. Get a piece of fibre or hickory, the latter being fine for the purpose; take an old wagon or buggy spoke and cut it down, if you can get nothing better. It is taken for granted that the proper insulation is used between wires where they lap, and so placed that it will not jar out.

Much has been written on soldering and banding, yet there is room in many cases for improvement along these lines. Though many use liquid flux, the writer would, for his own

part, use nothing but paste flux. While some of the liquids are not liable to cause trouble if carefully used, so much damage has been traced to them directly that it is a good policy to avoid their use on commutators. Sometimes a man will not admit it was the acid that caused the trouble, and goes on using it only to have his difficulties multiplied. A case is cited where it was necessary to rebuild a 500-hp commutator entirely, because of too much flux in fluid state, and not the hot kind either, but a saturated solution of zinc, alcohol and glycerine. Grounded commutators are not infrequent from this cause.

When bands are to be soldered is it not common to see a man drip acid nearly all over an armature, instead of lifting the bottle to the work and putting on only a little? It soaks into the insulation everywhere. Soldering, too, is an art, and how few know even now how to "sweat" the solder in properly! A joint does not depend on abundance of solder, but in getting in a little at the exact spot, hot enough to flow thoroughly and properly. Sometimes it is overheated; but the opposite fault is more common. Many a time has the writer examined connections made by a helper, and found no solder holding the wires together.

Of commutator troubles, too many times loose connections and poorly soldered joints cause arcing, mica burnt out to considerable depth, and flashing until springs are often burnt off the brush holder, and still more serious troubles follow before such a motor is cut out. Not all cars are managed by skilful men even at this late day in the history of electric traction; and not all systems are small enough to come under the watchful eye of the superintendent, manager or chief of the department. There are roads still being changed from cable to electric motive power, and the men will have all these things to learn anew. Too much care cannot be given to the details of this work. Armature coils are often judged by the winders; and often a good coil is turned down for what is supposed to be a defect, whereas it is a direct benefit to the coil. For example, a set of coils was discarded because they projected too high at the pinion end; had they been put in according to the requirements of that particular style, and pulled down with the band wires, the armature would have been very compact and free from vibration of coils.

Coils can fit too loose, as well as too tight. The winder is usually willing to learn, and welcomes a suggestion. Serious consideration is not often given to the many points of difference in coils.

Some railway systems demand an oil-proof varnish, on account of the oiling system. Some roads have changed from grease cups to patent oil boxes. In the first instance, the grease caused no damage; but under the new plan, oil has washed out the insulation and caused burnouts. Certain oils act as insulators; as a general thing, however, the oils used for lubrication of armature and axles are not of that class, when the insulation rots out, and condensation assists in the destruction. In such cases, an oil-proof insulating varnish is best. Where grease is used, the other class of varnish can be used, though the writer considers the oil-proof better, even then. Any varnish which is strong mechanically is certainly stronger electrically, and will stand a higher break-down test. Electrical tests on coils can be carried to a certain point and still count for nothing in actual practice. Because, too, there is not, and is not likely to be, a standard for comparison, since so many external conditions affect results in electrical break-down tests, comparisons are not of much value, as ordinarily carried on.

A coil which is advertised to withstand a certain break-down test may meet requirements perfectly at the time of testing, while the next batch of finished coils may break down far below this standard. Varnish may be overbaked, underbaked, there may be more moisture in atmosphere at one test than at the other; a different grade of linen may have been used, or a change made from one kind of oiled muslin to another, with perhaps different thickness as well.

No two samples of oiled muslin of different makes of the same thickness will have the same break-down point. Competition in prices has cut down the quality of many cloths. Some papers, too, are much better than others. Fish paper and its imitation, red ropes of many grades, leatheroid, extra No. 1, and others have their special characteristics and values. Coils have also other points for comparison, certain makes requiring reinforcement, not considered by all coil makers. Some winders have learned that this can be done during the making of the coil, shortening their work, and making the coil more lasting and far neater. This requires time and more material, and may cost more, but the coils are certainly worth the difference, provided the right kinds of varnish and other insulating materials are used.

Some of the best equipped works test each piece of fibre, fuller board, mica, varnished muslin, and each lot of insulating varnish, keeping a check on all materials used. This system has much to recommend it.

But tests made on a material at a certain time, and comparison made with a similar material months or even weeks later, must take into consideration all conditions at each test; and even then, results may go wide of what is expected. The best one can do in coil buying is to select the make on which are used the best obtainable materials, though the first cost may seem high. Results will prove them much cheaper in the end.

Extending Lighting Circuits in Completed Fireproof Building.

By T. W. Poppe.

IT is often necessary, in completed fire-proof buildings, to make extensions of circuits or change the outlets for electroliers to other parts of the ceiling. This work no electrical worker desires, as it requires patience, skill and a good general knowledge of the construction of the building.

As a rule, conduit is used. Flexible conduit such as "Greenfield" or "Steel-Armored" cable (BX) when used is more easily worked and installed than rigid conduit and makes a good job.

The procedure in changing the outlets is as follows: The new locations are marked and the outlet boxes set. If the outlet is for a single lamp only the box can be set with plaster of paris, a cavity being cut into the ceiling deep enough to allow the face or outside rim of the box cover to set flush with the ceiling. The box is then set or placed in the cavity and the plaster is forced around it. Plaster of paris when hard will hold the box firmly in place.

If an electrolier is to be suspended from the ceiling, a hanger must be provided. Where the flooring above the ceiling has been laid it is difficult to design a hanger that will hold the weight without cutting the flooring to insert it. Means must be provided to fasten a hanger securely in the ceiling without removing any flooring. For very heavy electroliers it is better to cut the flooring to place the hanger, a drop or threaded stem projecting through the ceiling. This hanger should be firmly cemented in place. For ordinary work the hanger shown in Fig. 1 has been found reliable.

The hanger is made up of two pieces of band iron bent as shown, holes ⅞ in. in diameter are drilled where indicated. The two band irons are then placed together at right angles and locked with nuts and a piece of ½-in. pipe about 2 in. long threaded its entire length. The lock nuts are firmly screwed against the band iron, and braces are then placed between the opposite sides of the hanger to hold the hanger rigid.

A hole the size of the box is next cut in the ceiling and gradually widened till it is three or four inches larger at the top than at the opening. The braces are then taken out of the hanger, the four prongs sprung together, the hanger placed in the hole and the braces replaced. The sides of the hole are sprayed with water till they are quite wet and cement is forced into the remaining space filling every crevice and thus imbedding the hanger. The hanger by this means becomes a part of the ceiling and is practically just as strong.

When setting the hanger space, equal to the depth of the out-

let box used, should be left between the ceiling line and the bottom of the hanger. The box can be locked on the hanger by placing a lock nut inside the box, screwing it on the ½-in. nipple. Plaster of paris can be placed in the cavities surrounding the box.

Chases are then cut from box to box and the conduit run in the shortest line connecting them. The old outlet box is removed from the ceiling and the conduit, if flexible, is joined to the conduit already in the ceiling by means of a combination coupling, one side being threaded for rigid conduit and the other moulded to securely hold the spirals of the flexible conduit. Such a coupling is shown in Fig. 2. If rigid conduit is used in making the extensions it is screwed to the conduit already in place in the ordinary manner. Circumstances do not allow this in all cases and a running thread or right and left-threaded coupling is used to connect them. A right and left-threaded coupling is preferable as it holds the pipe or conduit more firmly than a running thread.

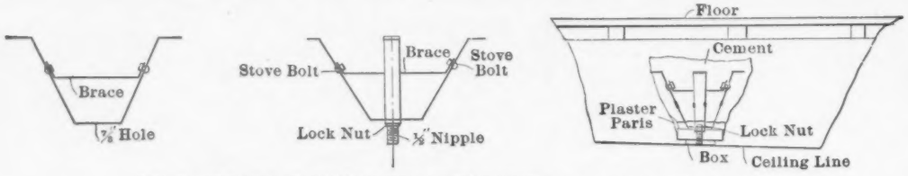


FIG. 1.—DETAILS OF HANGER FOR CEILING FIXTURE AND ITS APPLICATION.

FIG. 5.—CROWFOOT.

The conduit is fastened in the ceiling chases by drilling holes ¼ in. wide and 3 in. deep and driving wooden plugs firmly therein. Eight-penny finishing nails are then driven into the wooden plugs and bent over the conduit, thus holding it in the chase. Eight-penny wire nails are preferable to hooks, because of their smaller diameter and greater tenacity when driven in the wood. At least one-quarter of an inch should be allowed between the bottom of the conduit and the ceiling line. The chase is then filled with plaster of paris covering the conduit. The work thus becomes part of the ceiling. Outlets for brackets are replaced in the same manner, it being necessary to plaster the box in the side wall, using a fixture stud (Fig. 3) in place of a hanger.

It is sometimes desired to make extensions quickly and with a view to economy rather than permanency. In a case of this kind moulding can be used and while not making as neat appearing a job as that already described would be passable when the corners are mitred and all joints well made. The moulding can be arranged in panels, star, circles or any design which might be desired for decorative purposes. For side lamps a fancy moulding can be obtained and stained to suit the woodwork of the room or store where it is being installed.

Moulding can be fastened to the fire brick or cement ceiling by drilling a hole one-quarter of an inch in diameter and four inches deep. A wooden plug is then driven into the hole. Holes to suit the wood screws to be used are then bored through the center of the moulding and the moulding screwed to the ceiling. The holes for the plugs should be drilled into the ceiling at an angle and not perpendicularly. This avoids any danger of the moulding falling should the wooden plugs shrink and loosen in the holes. Expansion screws may also be used. Screw anchors can be obtained at any reliable hardware store and can be used with the ordinary wood screw.

FIG. 2.—COMBINATION COUPLING.

FIG. 3.—FIXTURE STUD.

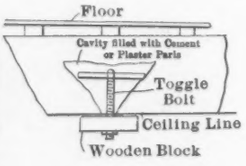


FIG. 4.—TOGGLE-BOLT HANGER.

Should an electrolier be used in connection with the moulding a hanger similar to the one shown in Fig. 1 can be used, substituting a wooden block one and a quarter inch thick and as large as desired in place of the outlet box. These blocks should be bored so as to allow the wires to come through near the center. Care must be taken to keep a wall of wood between the wires as required by the Underwriters. The blocks when used with the hanger are fastened to the ceiling by using a half-inch pipe nipple long enough to project one inch below face of block. A seven-eighth-inch hole is bored through the center and a lock nut is used to hold the block against the ceiling, a washer being placed between the wood and lock nut. Should lamps close to the ceiling be desired there are various makes of lamp receptacles which can be fastened to the moulding direct.

If a fixture cluster is to be used close to the ceiling a cone-shaped hole can be made in the ceiling, the apex of the cone pointing downward. A toggle bolt is inserted and fastened by forcing plaster of paris or cement in the hole. A hole large enough for the toggle bolt is bored in the center of a block of wood as previously described and the block placed against the ceiling, the toggle bolt protruding. The block is locked against the ceiling by screwing the nut on the toggle tight, a washer being placed between the wood and nut, shown in Fig. 4.

A crowfoot (Fig. 5) is fastened to the block with wood screws one and a quarter inches long. The cluster is screwed into the crowfoot before the latter is placed in position. Care should be taken when fastening the crowfoot not to cut the insulation of the wires in the block with the screws. Fixtures are often grounded within themselves and should a wire of the opposite polarity also become grounded there would be a short-circuit through the screw, crowfoot and fixture.

Should the extension be made from the former outlet box a block can be fastened to the cover of the outlet box by drilling and tapping holes in the box and by boring holes in the block to correspond. Screws can then be used to hold the block in place.

The Design of a 12-in. Induction Coil.

By Wm. O. Eddy.

THE aim of this paper is to show the application of the principles of induction coil design, taking for illustration a 12-in coil. It is not to be expected that an amateur without experience or a study of the work of others should be able to design an effective and efficient coil, since there is no definite and fixed course that can be followed to obtain a desired result. Therefore, in many places it is necessary to accept the experience of others as well as using "cut and try" methods.

The design below is for a good all round coil for laboratory use, one that will give a good spark with a small amount of current, and which will also deliver a comparatively large amount of power when required; a coil that can easily produce a 12-in. spark.

THE COIL.

We will begin the design for such. The core will be made 2⅛ in. dia. by 24 in. long, composed of a bundle of No. 22 iron wire well annealed. Several writers advise a core 1½ x 19 in. for a 12-in. coil, but a more powerful field than such a core can produce will be obtained from the core selected. The diameter of the core selected compared to its length is about 1 to 11⅓, which is a good ratio for such a coil, and will allow the use of a high speed interrupter when desired.

THE PRIMARY.

The primary will be wound with about two and a half layers of No. 12 double-cotton-covered wire. This will give the maximum number of ampere turns which will probably ever be required and the winding for the last of only a half layer will enable one to bring out the taps without inconvenience; the extra flexibility of this arrangement compensating for the space wasted at the end of the half layer.

From wire tables it is found that there can be wound about 10.4 turns of No. 12 double-cotton-covered wire to the inch, so if an inch of space be allowed at each end of the core 230 turns

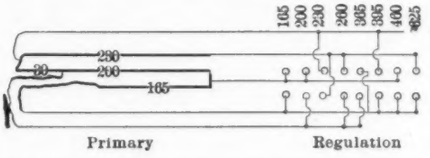


FIG. 1.—ARRANGEMENT OF LAYERS OF WINDING.

can be wound in the remaining 22 inches. The layers will be made continuous by bringing out a connection at the end of each layer and tapping the second at the end of 30 turns and winding only 165 turns for the third layer. Two thicknesses of impregnated paper between layers will be sufficient for insulation.

The sketch of Fig. 1 shows diagramatically the arrangement of these layers and taps; the variable inductance feature may be worked with either switches or plugs to obtain any one of the 8 combinations. These connections cut into the primary circuit the following numbers of primary turns—165, 200, 230, 260, 365, 395, 460 or 625.

THE INSULATING TUBE.

Before determining the thickness of the insulating tube it is necessary to find the voltage that this tube must withstand.

Curve *A* of Fig. 2 shows the ratio of spark length to voltage in air between needle gaps as determined and used in high-potential transformer testing; but this voltage is as read by an alternating-current instrument and is based on a sine wave, the meter registering "root mean square" values. The ratio of the maximum is to this effective value for a sine wave as 1 :1/12. Since it is the maximum value which determines the sparking distance, curve *B* has been drawn to show these maximum

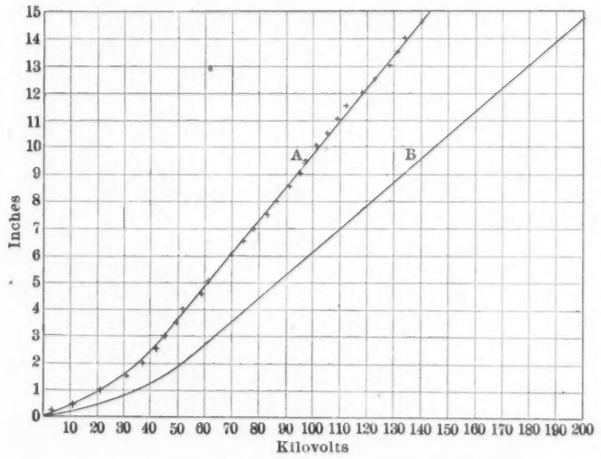


FIG. 2.—RATIO OF SPARK LENGTH TO VOLTAGE IN ARC.

values. The abscissas of this curve represent potentials and the ordinates represent sparking distances and the potential in kilovolts can be read off directly from the curve for any spark length in inches.

It will be seen from curve *B* that the coil which must give at least a 12-in. spark must withstand a potential of about 170,000 volts. Experience has shown that it is necessary to insulate for only ¾ of the maximum spark length, which in this case would mean about 130 kilovolts.

Hard rubber, or ebonite, will be selected for the material for the insulating tube, and from Table I it is seen that the rupturing voltage for this substance varies from 900 to 1,500 volts per inch of thickness. If the lowest value given be used and a factor of safety of 4 be taken on a safe value of 175 kilovolts per inch, a thickness of ¾ in. will be required for the insulating tube. The length of this tube for a 24-in. core should be at least 26 in.

The inside diameter should be such that the primary and the core will fit snugly inside of it. The layers of the primary, even with the insulating paper between them, will fit into each other to a certain extent, each turn falling between two turns of the adjacent layer; therefore if the paper is .006 thick and two thicknesses be put between each layer and the next and a half dozen or more between the primary and the core, at least ⅝ in. inside diameter must be allowed for the primary. This will give 2¾ in. for the inside and 3½ in. for the outside diameter of the insulating tube.

THE SECONDARY.

It has just been found while calculating for the insulating tube that a secondary potential of 170 kilovolts will be encountered. There must be therefore such a number of secondary turns as will, under normal working conditions of the primary, give this potential.

From 50,000 to 80,000 turns represents good practice for a 12-inch coil. Simple calculations will show that at the primary tap giving 260 turns, which is a fair working point, and with an interrupter working on direct current giving an effective e.m.f. across the primary of 40 volts, the number of secondary turns for 17,000 volts should be 55,000.

The above calculations assume that with the given design of coil all the secondary is wound in the most effective part of the field and a large current is used such as would fully magnetize the core before "break." It is desirable, however, with the present design to obtain the spark with a comparatively small amount of current and it is preferable, therefore, to take advantage of data obtained from experience in the construction of other coils and use somewhere in the neighborhood of 70,000 turns.

For the secondary wire No. 34 is best adapted. It is best also to wind the sections in "pies" of ⅛ in. thick. This size of wire can be wound after it has been through a bath of hot paraffin wax, on an average of about 912 turns to a pie of cross section ⅛ x 1 in. and by a cut-and-try method it is found that 70,000 turns can be placed in 60 pies having an average cross section of ⅛ x 1⅜ in. The secondary winding should have about 1 in. for insulation between it and the insulating tube, to prevent the spark from jumping to and across the surface of this tube. At the ends of the coil where normally the potential is highest this insulation should be increased. Thus the insulation between primary and secondary would resemble a series of steps from the centre outward.

Applying these additional considerations to the calculations of the number and size of the secondary pies, the design will be as follows:

18	pies	4½-in.	internal diameter and	1½-in.	cross sectional length.
18	"	4⅝-in.	" "	1⅜-in.	" "
24	"	4¾-in.	" "	1¼-in.	" "

giving 60 pies and approximately 74,000 turns.

This will give a uniform outside diameter of 6 in., which is in good proportion for a 12-in. coil with the chosen core dimensions.

It is proper to assume that the laboratory coil will sometimes be used with condensers across the secondary and that it will be desirable to choke back high frequency oscillations. For this purpose there will be added two coils at each end wound with No. 28 double-cotton-covered wire, to the same thickness, and external diameter as the other pies and 4¾ in. internal diameter. This will add less than 1,000 turns; so that there will be approximately 75,000 turns on the secondary.

Even when wound with less than 60,000 turns on the secondary, the above coil would give a 12-in. spark but would require, when tested under the same conditions in the primary circuit, one-third more current than the present coil; while a coil wound with about 53,000 turns of the same size wire, cotton covered and thus more wasteful of space, would require one-half more current, using in each case a Wehnelt interrupter.

With the same dimensions a coil for wireless telegraphy work

Table I.—Rupturing E.M.F. in Kilo-Volts per Inch.

Substance.			Rupturing e.m.f.
Ebonite			900—1,500
Glass			500
Window glass			380—1,000
Gutta percha			250—1,000
Mica			1,500—5,000
Micanite			2,500—7,500
Paraffin wax			330— 650
Petroleum			230
Impregnated paper:—			
Thickness.			
.0047	1,000	Thin printer's paper.	
.0035	1,300	Tissue paper.	
.0071	1,100	Manilla paper.	
.0051	1,600	American linen paper.	
.0055	1,350	Linen typewriter paper.	
Boiled-out linseed oil			215
Light mineral lubricating oil			120
Paraffin oil sp. gr. .28			165—250

would have required a primary with three complete layers of No. 10 wire and No. 32 for the secondary, wound more effectively since the smaller number of turns for an equal bulk of this wire would give a lower potential, which would require less space for insulation. The coil could probably no longer be rated at 12 in., but it would be far better adapted to heavy wireless work, because of the decreased resistance of a shorter length of larger secondary wire and the increased ability to handle a large volume of current. Since in this class of work an extremely rapid interrupter is not advantageous, the coil could have been improved by making the core of larger diameter and thus increasing the amount of iron, thereby having in common for the two coils only the length of the core.

In joining up the separate pies the insides and outsides of consecutive coils should be connected together with the necessary thickness of insulation between them. When dealing in such large numbers and using factors of safety of 3 or 4 it is necessary to estimate only approximately, and slide rule calculations are wholly adequate for most of the preliminary work.

Assume that the impregnated paper between the pies has a thickness of .006 in. per sheet. This insulation must withstand, for the method of connection which has been chosen, double the potential generated by a single pie, or $\frac{170{,}000 \text{ volts}}{60 \text{ pies}} \times 2 =$ 6,000 volts, roughly. From the accompanying table it is seen that this paper will rupture at 1,200 volts per 1/1,000 inch. Using a factor of safety of 4 there will be obtained 1,800 volts per sheet, which would require four sheets between each pie or section.

The winding will now take up 60 pies × ⅛ in. each = 7½ in. and another ½ in. for the four end coils, making 8 in. Four thicknesses of paper × .006 in. per sheet × 64 coils = approximately 1½ in. for the total thickness of the paper and 9½ in. for the entire secondary. It has been found that a good length for the secondary might be considered that of the sparking distance of the coil if it is desired to err on the side of safety and have the least danger of the spark jumping inside of the secondary or across the surface. To prevent this on the outside it is necessary to increase the thickness of the insulation if a short secondary is used, and this has its disadvantages. In the coil being designed it is desirable to make everything as immune from breakdown as possible, and therefore another two or three inches will be utilized for insulating purposes.

From the manufacturers' standpoint, paper discs are a more expensive insulation than the wax in which coils are imbedded, so that it might be well to increase the number of paper sheets from 4 to 6 and use the rest of the space for insulating compound, or for oil if the coil is to be immersed. It is convenient to cast the secondary in a number of sections, and between these sections the remaining space will be distributed. The paper discs should extend beyond the winding at both the inside and the outside diameters.

It will now be interesting to compute the length and weight of the secondary winding. The average diameter of the larger pies is 5¼ in., which multiplied by π/12 gives 1,375 ft. for the average length of one turn; 1,375 ft. × 18 sections × 1,368 turns per section = 33,900 ft. for the number of feet of wire in the larger sections in the center of the coil. Computing in the same way there are obtained 31,400 ft. for the intermediate and 38,600 ft. for the end sections, making a total of 103,900 ft., or about 19¾ miles of No. 34 wire weighing about 15 lb., and having a resistance of about 27,000 ohms at 20° C. The four end coils add a weight of about ½ lb. of No. 28 wire. The primary contains over 400 ft. and weighs over 10 lb. and the core will weigh about 20 lb., so that the wire and iron alone in the coil will weigh nearly 50 lb. without insulation or mountings.

THE CONDENSER.

Working with a Wehnelt interrupter the coil will require no condenser. With a slow vibrating hammer break and heavy current it should not require more than one microfarad of condenser capacity. The capacity should be made adjustable for different conditions of working and different currents and interrupters.

The formula for the capacity of a condenser in microfarads is $C = \frac{885 \times \textit{effective area in sq. cm.} \times K \times 10^{-13}}{\textit{thickness of dielectric in cms.}}$.

If the same paper is used as before, .015 cm. thick, there should be two sheets, which will make a thickness of .03 cm., and from

Table II.—Average Specific Dielectric Capacity.

Air	1
Ebonite	2.5
Glass { Flint	5—10
Glass { Crown	3—6
Gutta percha	2.7
India rubber	2.3
Mica	6.5
Shellac	2.8
Sulphur	3—4
Paper impregnated with paraffin	3.7
Paraffin wax	2
Petroleum	2.5
Turpentine	2

Table II it is seen that the value of K for this paper is 3.7. Let us now find the capacity per sq. ft. of active surface. One sq. ft. = 930 sq. cm.

$$C = \frac{885 \times 930 \times 3.7 \times 10^{-13}}{.03} = .01 \text{ m.f.}$$

Thus one can easily calculate the number of sheets of foil and paper for any desired capacity by taking the value of .01 m.f. per sq. ft.

SUMMARY OF RESULTS.

Core, 2⅛ in. by 24 in.; insulating tube, 26 in. by 2¾ in. inside diameter by 3½ in. outside; primary, 2½ layers No. 12 wire, 230 turns per layer; secondary, No. 34 wire wound in ⅛-in. sections, each 6 in. external diameter.

Number of Section.	Inside Diameter.	Number of Turns.	Total number of Turns.
18	4½	1,368	24,624
18	4⅝	1,254	22,572
24	4¾	1,140	27,360
4	4¾	175	700
64			75,256

The above coil when worked on with direct current at 110 volts with a Wehnelt interrupter will give a 12-in. spark on about 12 amp. of current, using 165 primary turns, and a 14.5-in. spark using 13½ amp. The secondary terminals should be so placed as not to allow a greater spark than 14½ in. Using two full layers of the primary winding and 10 amp. of current there can be obtained a heavy and powerful discharge across an 8-in. gap.

The Purification of Lubricating Oil—II.

By JAMES L. GRANT.

In the December 1 issue a number of oil filters were described. Figs. 7 and 8 illustrate another filter and in order to convey a good idea of its construction and operation it is necessary to describe the illustrations together as follows: In this case it is

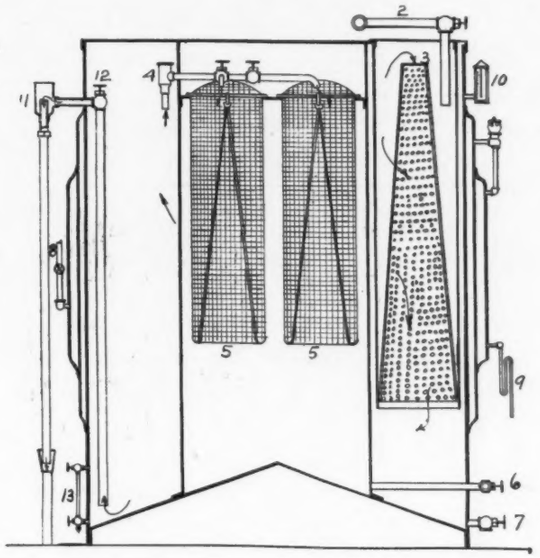


FIG. 7.—CROSS-SECTION OF OIL FILTER.

assumed that the filter forms part of a complete oiling system in which oil is used on various bearings and sent to the filter through 2, from where it passes to the cone-shaped strainers,

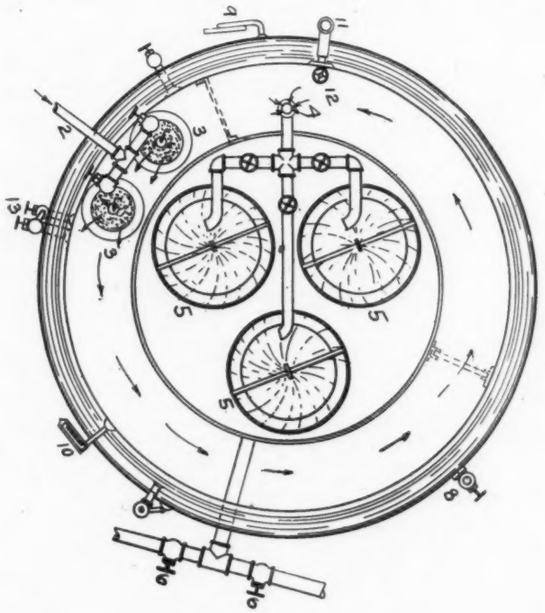


FIG. 8.—PLAN VIEW OF OIL FILTER.

3, which catch the coarser impurities on their large outer surface. In case the perforations are all closed through lack of attention, the oil does not overflow on the engine room floor, but goes in at the open top until the strainer is cleansed.

The oil then passes out of the larger end of these strainers and goes into the settling chamber, which should always be full of oil. It then slowly travels around and upward until it reaches the passage, 4, and is delivered to the filter bags, 5, consisting of bags of fine cloth, which remove all remaining impurities and deliver clean oil to the central chamber below them. From this it is drawn by the valves, 6, for general use. Impure matter is drawn off through 7. During this process the filter is kept at a satisfactory temperature by steam turned into the jacket shown, through the valve, 8, and water resulting from condensation is drawn off through the trap, 9. The temperature is indicated by the thermometer, 10. If the oil to be cleansed is mixed with water the latter falls to the bottom and is drawn off through 11. As this discharges from the bottom of the filter only, it can take nothing but water so long as any is found there, and when it is all taken out the valve, 12, is closed to prevent the escape of oil. A water gauge, 13, shows the amount of water in the settling chamber.

While the use of a good oil filter results in saving a very large per cent of the oil that would otherwise be lost, there is another and far more important advantage due to its installation. Every engineer worthy of the name will strive to run his plant at the lowest possible cost consistent with safety and true economy, therefore he will use the smallest amount of oil possible, if it can only be used once, and this is a dangerous plan because where a sight feed oiler is set to feed very slowly a small piece of waste or other foreign matter that we find in unfiltered oil will stop it altogether, causing the bearing to heat before the engineer is aware of the condition of affairs. Nobody knows how this matter gets into oil, but we do know that it is found there.

On the other hand, if provision is made for catching the oil used in pans and filtering it for further use, the engineer feels at liberty to set the oilers to feed faster, as the amount really used and discarded is quite small. In this connection it is well to remember that one hot box or bearing may cost as much as several barrels of oil.

Some bearings on engines are so located that it is not practical to catch oil from them, therefore in order to prevent it from running on the floor the engineer puts down good waste to absorb it, and when this waste becomes saturated it is thrown into the furnace. If a filter is provided, such waste may be wrung out by hand (if no better way for extracting the oil is provided), and much of it reclaimed for future use, even if it is very dirty.

Fig. 9 is a very simple filter that will do good work where the oil to be purified is not excessively dirty. The impure oil is poured into the upper chamber, 2, the bottom of which is perforated, thus allowing it to pass through the filtering material which in this case is best white waste nicely packed in place. This removes nearly all impurities, but if there are any left they are sure to be of the heavier kind, and as they fall on the slanting or concave bottom of the chamber, 3, they are washed down towards the center where they lodge against the vertical stand pipe, but cannot enter it until the oil is several inches deep at this point, and even then they are not liable to enter it because they are usually too heavy to float.

When the oil has collected until its surface is on a level with or slightly above the bottom of the fine strainer shown, it slowly goes into the vertical tube which conveys it to the bottom of the pure oil chamber where it must pass through warm water which washes it as it ascends. The water is heated by a coil of pipe through which steam circulates. The amount of steam used for this purpose is not great enough to be worthy of mention, yet if the filter is located in a cold place during the winter season, the heat thus applied will cause the oil to be purified both quicker and better.

Fig. 10 is a more elaborate filter that may be used where oil is poured into the upper chamber in the usual way, or in connection with an oiling system in which many bearings are lubricated from a common source of supply, after which the oil runs into the filter through the pipe shown at 2 and falls into the upper chamber, 3, then gravitates to the smaller central filtering chamber, 4, where a larger portion of the impurities are removed. This brings it to the settling chamber, 5, where any foreign matter that may remain has a chance to set-

tle before the oil rises to the top of the central tube and falls into it. This conveys it to the lower part of the water reservoir and three deflecting devices, each broader than its predecessor, carry it outward and it ascends through warm water until it meets more filtering material, through which it passes in an upward direction to the pure oil chamber, out of which it is drawn by a pump through the gate valve, 6.

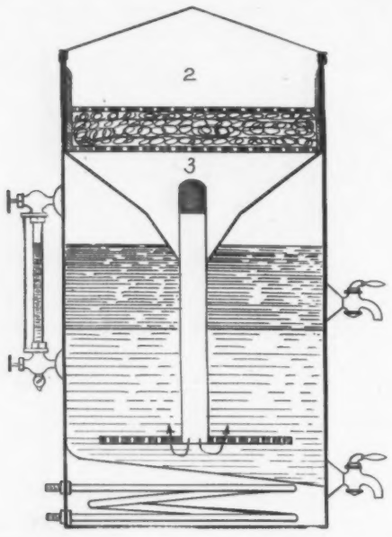


FIG. 9.—FILTER FOR OIL NOT EXCESSIVELY DIRTY.

Clean oil is always desirable for several reasons without regard to the system adopted for using it, but it must be clean where a gravity system is in use, as otherwise dirt and sediment will clog the pipes and render them useless until cleaned. As this would prevent operation of the oilers it could not be tolerated, as it would be too expensive, therefore an efficient filter is an essential part of such a system.

Fig. 11 illustrates a filter that is designed to cleanse cylinder oil or any other heavy grade that has been used on bearings or in the crank cases of engines. Impure oil is poured into the waste oil chamber, 2, surrounding the filtering device, 3, which is filled with animal bone black. As the sides are perforated, the oil works through this fine filtering material horizontally, until it enters the central tube, 4, which brings it to the lower part of the water chamber, where it is washed, and rising to the highest point possible is ready for use.

This process is made practicable my means of a coil of pipe in the hot water chamber, 5, through which steam circulates for the purpose of keeping the water hot at all times. If this feature was omitted, it would either be impossible to handle this kind of oil at all, or the capacity would be very small, especially as it is not assisted directly by gravity. As this device is located in the upper part of the filter it renders the oil limped when it is first put in, making it possible to do good work from the start. There is also a coil of steam pipe in the lower part, that keeps the water warm in which the oil is washed as a part of the process.

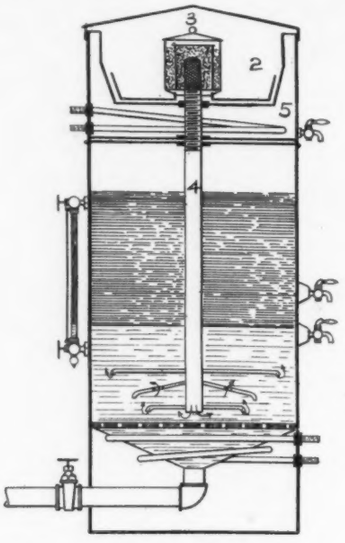


FIG. 11.—FILTER FOR HEAVY OILS.

Fig. 12 represents what is known as the "unit type" of oil filter, as it consists of two or more parts that operate separately or together as desired. Waste oil is poured into 2 and after passing out through a strainer goes to the filtering devices, 3 and 4, both of which are covered on the outside with finely woven cloth and contain animal bone black through which the oil must pass. Under this part there is a hot water chamber which liquefies the oil and enables it to pass through the filter quickly. It is then washed and stored in the clean oil chamber, 5, for future use.

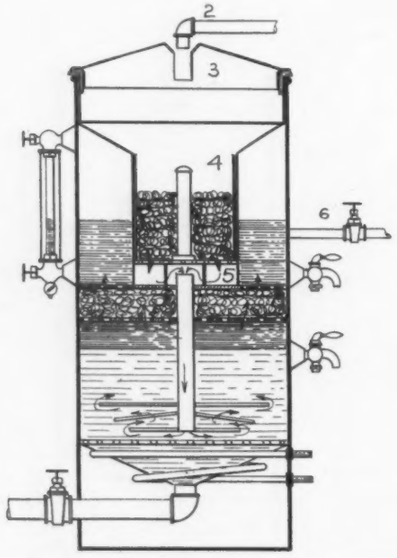


FIG. 10.—FILTER FOR USE IN CONNECTION WITH OILING SYSTEM

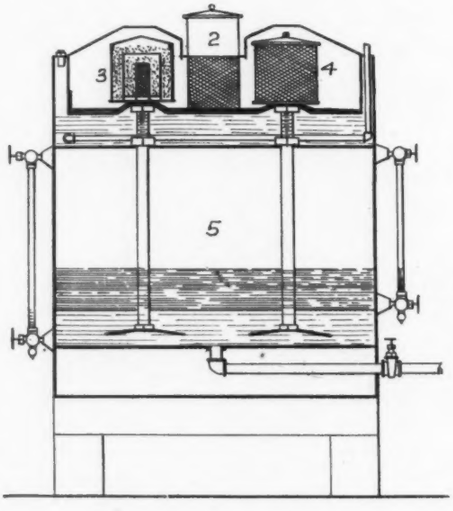


FIG. 12.—UNIT TYPE OIL FILTER.

Burning Bituminous Slack and Lignites.

BY GEORGE P. HUTCHINS.

MUCH has been written upon the subject of boiler and furnace efficiency with a view to emphasizing the necessity of betterment in this direction. Steam engine design and construction have advanced to a stage where the largest and most modern power stations are enabled to obtain about 13 per cent of the total heat of the fuel, as indicated horsepower. This is only half of the theoretical power obtainable in an engine from the coal as calculated for Rankine's idealized steam engines in which losses by friction, radiation, etc., are eliminated.

It appears, however, as if the commercial limit of steam engine efficiency were nearly reached and leading boiler makers hold little hope of improvement upon present practice to any considerable extent; 70 per cent efficiency as excellent practice and 80 to 82 per cent under the most favorable conditions of test have stood for many years with comparatively little improvement.

A careful survey of the whole field shows two directions in which further steam plant economies must be sought: the first, in the construction of furnaces whereby a better heating effect may be generally realized on the coal burned, and second, practicable means of more generally utilizing cheaper fuels, such as bituminous slack, lignites, coke "breeze," etc.

Of the cheap fuels only bituminous slack and lignites will be considered here, not but what there are cheaper fuels, but these are, in most sections of the country, the cheapest available. Culm, coke "breeze," etc., while cheap enough and good enough as fuels to deserve serious consideration are so little suited to ordinary furnaces and so rarely purchasable any distance from the source of supply that they are necessarily unavailable to a great majority of steam users.

It is unquestionably true that economy is frequently manifest in the inverse ratio as between the prices of two coals. So far as a general deduction from this statement may be made, it is that there is an element of suitability in method of firing, in the style, size and shape of furnace, grate bars, draft, etc., to different coals, which bear fully as strong a relation to fuel economy as the proximate analysis, size and character of the coal itself.

If by suitable modifications of the furnace, draft, etc., and after thorough study of the conditions by an experienced engineer, it can be demonstrated that a cheaper fuel can be burned under the boilers and the required capacity still maintained, there remains only one question to settle: Will the savings in fuel pay a satisfactory dividend on the money invested in furnace modification?

In this article, the writer proposes to demonstrate two points and to cite instances in proof of points developed. The first is, that it is a practical impossibility to obtain highest economy out of cheap bituminous coal or lignite in an ordinary boiler furnace by hand firing. The second is, that proper mechanical stokers not only provide the most efficient method of burning cheap fuels, but that the saving thus effected quickly pays for the stoker installation.

Bituminous coals are classified as including all coals within the following limits of chemical composition: Fixed carbon, 50 per cent to 75 per cent; volatile matter, 25 per cent to 50 per cent.

Lignites, including the so-called brown coals, form the group in which the fixed carbon comprises 50 per cent or less of the total weight, and the volatile matter 50 per cent or over. In these coals, especially the cheaper varieties of slack, the contents of ash or non-combustible earthy matter varies greatly, but a fair average for cheap grades may be taken as 8 to 10 per cent; the minimum value up to 20 per cent, 25 per cent and occasionally in the far Western coals as high as 30 per cent, or even more.

Ash or non-combustible matter exercises a three-fold deleterious action. It absorbs a considerable amount of heat from the coal. It clogs the fire, causes clinker and interferes with the free and rapid combustion of the carbon. It acts as a dilutant to the coal necessitating more frequent firing with the handling of a large amount of coal and ash.

It is a direct conclusion from this statement that the presence of high percentages of ash serves to exaggerate the disadvantages of hand-firing methods.

In introducing the subject of smoke and smoke prevention the writer perhaps opens himself to the criticism that the facts and explanations are not new; but in extenuation points to the smoky chimneys in nearly every city in the country to show that there are still many upon whom the true significance of smoke and smoke prevention has not yet been fully impressed. If the repeated statement of old truths avails to emphasize this most important feature of steam plant operation, this effort will have not been wholly in vain.

In Kent's "Steam Boiler Economy" it is stated that "Of all known methods of burning soft coal the worst is the one most commonly practiced, viz.: that of burning it in a common furnace consisting of a set of grate bars and a space of contracted dimensions between them and the heating surface of the boiler, the coal being fired by hand. This method is suitable for anthracite coal, but when used for bituminous coal it is objectionable both on account of the smoke and on account of the loss of economy."

The following summarized paragraphs which clearly emphasize the prodigal waste attendant upon, and inseparable from, firing soft coals by hand. The sequence of events between two consecutives firing with bituminous coals explains the difficulty of obtaining high economy by hand firing.

When 100 or 200 lb. of green coal is spread upon the fire the first effect is to stop the air passages and choke off the air supply. Next is the rapid evaporation of the moisture which partially chills the furnace. The third is a further chilling process by the formation of water gas from decomposed steam and carbon. This water gas passes off largely unburned.

The fourth effect is the distillation of the volatile hydrocarbons, a considerable portion of which escape unburned owing to the deficiency of the hot air. During all this time the greatest volumes of smoke (water gas, hydrogen, unburned hydrocarbon gases and finely divided carbon) are escaping up the flues and soot is being deposited on the heating surfaces, lowering their efficiency.

Gradually the volatile matter is all driven off and air passages burned through the bed, the temperatures of the furnace rises, and the fixed carbon residues of the coal burn strongly and the best possible adjustment of air supply is obtained and the stack becomes smokeless. The next effect, however, is the burning down of the fuel bed, the excessive passage of air through the furnace and a new condition of poor economy is reached, the excess air carrying up the chimney the heat which should be utilized in the boiler.

There is no layman so ignorant of combustion phenomena as not to know full well that one of the quickest and surest ways of cooling any fire from a kitchen range to a 500-hp boiler furnace is to open the front door and admit large volumes of outside air into the furnace over the fire. Yet very few plant owners, managers and engineers have any idea of the proportion of the time that the front doors of the average boiler furnace are kept wide open for firing green coal, slicing and cleaning fires. Mr. W. E. Snyder, of the Engineers' Society of Western Pennsylvania, stated in a paper read before that body, that in observations made by himself the furnace doors were open for 2 minutes and 29 seconds every 7.7 minutes, making 7 hours and 12 minutes in every 24, that they were open to permit firing and cleaning. To make such an observation complete a record of the furnace temperatures just beyond the bridge wall should be taken. This temperature drop means loss of boiler capacity and efficiency. Thus it appears that two requirements of a high-efficiency method of firing soft coal are a gradual and steady feeding of coal and uniform furnace temperatures. Both are absolutely impossible with any known method of hand firing.

Commercial smoke cures are of two general classes: smoke dilution appliances in which steam jets, consuming all the way from 8 per cent to 15 per cent of the steam generated by the boiler, figure prominently, together with means of admitting air above the fire, and stokers. It has yet to be demonstrated that the former devices have any real merit in reducing fuel costs and increasing the efficiency and capacity of the boiler plant. Especially is this true when these devices are compared with the performances of any of several different types of mechanical stokers which constitute the second class of smoke cures.

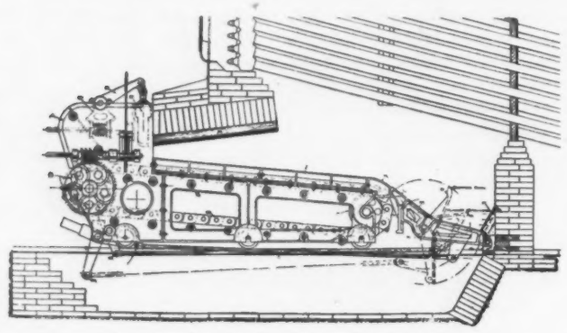


FIG. 1.—AMERICAN CHAIN GRATE STOKER.

In order to burn soft coal, high in volatile matter, without smoke and at highest efficiency, it is absolutely necessary that several requirements be fulfilled. (1) The green coal must be supplied gradually to allow the furnace heat to expel the volatile matter by gradual distillation. (2) There must be a thorough mixture of the gases thus formed with sufficient air to assure their complete oxidation. (3) These gases must be heated to the point of ignition and not allowed to cool off either by mixture with cool air or by contact with the cooler boiler surfaces, until the combustion is complete. (4) A combustion chamber of sufficient size must be provided and it is highly advisable that it be largely enclosed in fire brick except where certain types of stokers are employed.

Combustion of soft coal can only be complete when it is progressive. The volatile matter must be expelled or distilled off at first and burned by itself and after the residue of coke. Progressive combustion is accomplished with a measure of success by a few firemen of unusual skill and care with certain forms of furnace construction, and under certain conditions these results may compare favorably with the results of many types of mechanical stokers. Cases where results of this character are accomplished are, however, very unusual, and it generally happens that firemen are not the poorest paid employes in a power plant,

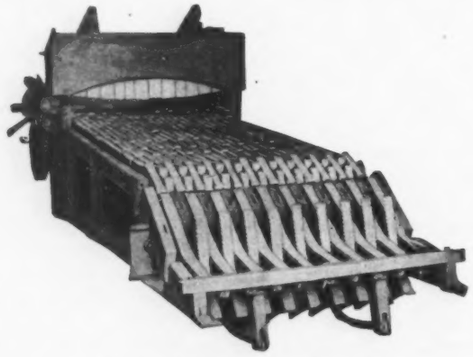


FIG. 2.—CHAIN GRATE STOKER.

but the least careful and intelligent and cannot be counted upon to show good results in fuel economy.

Mechanical stokers are variously classed, but the division into overfeed, chain grates and underfeed is convenient. Overfeed stokers are of several styles, being, in general, grates down which coal is fed from a magazine or hopper at the top. The actual workings of these stokers, as accomplishing progressive combustion, are no different from chain grates where the results are rather more easily traced.

By reference to the accompanying illustration (Fig. 1), which shows the improved chain grate of the American Stoker Company, it will be noted that coal enters the furnace from a long trough under a feed grate, the variable height of which determines the depth of fuel on the grate. A broad ignition arch over the front half of the fire and kept at white heat by radiation heats the coal as it enters and expels the volatile matter. This volatile matter mixes with air coming through the front of the stoker and grate and passes under the low white hot arch over the fire, to be thoroughly ignited and burned in the forepart of the furnace. The coke or residue of the coal travels forward as the grate advances and is gradually and fully consumed without smoke. Two objections have prevailed against chain grates; one, that it is difficult to prevent bare spots on the grates when running light, especially at the rear end, and the other that when running at full capacity there is apt to be a heavy waste of partly burned coal into the ash pit, dumped at the turn.

With proper design and proportion of grate surface and reasonable care in manipulation the first objection should not appear. In many types of chain grates the second disadvantage is very real, but the rear attachment shown in Fig. 2 represents a successful effort to overcome this waste of coal in the ash pit at the inside turn of the grate. Two sets of bars are provided which receive all of the ash, clinker and partly burned coal at the turn. The shorter set of alternate bars may be raised by a lever to break the clinker and when both sets of bars are lifted simultaneously all accumulations of dead ash and clinker are dumped into the ash pit. Draft for a stoker of this type is nearly always natural or induced, but a number of modifications and dampers may be introduced to regulate the intensity of air supply at different points of the grate or rear attachment, depending upon the depth and length of the fire carried.

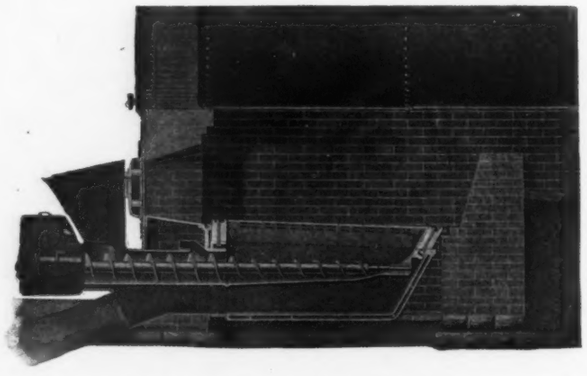


FIG. 3.—AMERICAN UNDERFEED STOKER.

The American underfeed stoker, as illustrated in Fig. 3, consists essentially of a screw conveyor actuated by a direct steam motor, or from a line shaft by ratchet or pawl, which forces the green coal into the furnace under the center and hottest part of the fire. The coal enters the trough or retort and is crowded upward by the pressure of that behind. The slow roasting essential to progressive combustion takes place as the coal approaches the fire.

The gases rising are mixed with a supply of air under forced draft which enters the fire through a series of hollow tuyere blocks surrounding the retort. The only avenue of escape for the smoke-producing gases lies through a bed of incandescent coke from 10 to 15 in. deep, so that the volatile matter is consumed before the gases come in contact with the boiler cold surfaces. As more fresh coal crowds up from below the burning coke overflows the tuyeres and rests upon the side grates until consumed.

This matter of subsidiary grates in connection with a stoker

of this type deserves especially close study and skill in designing an installation. The clinkering properties of the coal, the amount and character of ash, the nature of the coal itself and the character of the loads carried by the boilers may all influence these details. Various combinations of dead grates, plain and herring-bone grates, and dumping shear grates, etc., are employed in different installations, but so far do these questions relate to individual plants and fuels that it is nearly impossible to make general statements.

The control of the forced draft is a strong argument in favor of this type of stoker, more particularly where fine coal is to be fed. The forced draft admits of great flexibility; it may be divided in any suitable proportion between ash pit and tuyeres with closed or open ash pit doors, as circumstances dictate. With Eastern fuels this control of draft and the relative combustion in stoker proper and on the side grates is not as much appreciated as with Western fuels, high in volatile matter and ash. It is worthy of note that with the underfeed stoker it is impossible to have any waste of fuel and unburned coal into the ash pit.

It has been stated that "figures don't lie," but in the case of stoker tests the figures yielded may, while perhaps not exactly "lie," still give a most distorted idea of the truth, especially when compared with hand firing results. The knowledge and ability of the fireman, the cleanliness of the boiler inside and out, previous defective conditions of draft, grates (if existing), etc., all may help to show an unwarranted disparity between the stoker and hand firing. It is for this reason that the writer hesitates to give any figures. The following results

	Stoker Fired.	Hand Fired.
Duration of trial	9½ hrs.	9 hrs.
Pressure of steam	126 lbs.	120 lbs.
Temperature external air	80 deg.	43 deg.
Temperature boiler room	87 deg.	65 deg.
Temperature flue average	516 deg.	....
Temperature feed water	73 deg.	41 deg.
Kind of coal, O. Stark Co., bituminous.	12,000 B.t.u.	18,843 B.t.u.
Total coal burned	22,017 lbs.	22,522 lbs.
Total dry coal equivalent	21,576 lbs.	22,071 lbs.
Moisture in coal	2%	2%
Total ash	2,982 lbs.	2,465 lbs.
Total ash percent of coal burned	13.6%	10.94%
Amount of unburned carbon in ash	....	52%
Coal burned per hour	2,317 lbs.	2,502 lbs.
Water evaporation, total actual	183,287 lbs.	136,568 lbs.
Water evaporation from and at 212°, per lb. dry coal	10.1 lbs.	7.57 lbs.
Water evaporation from and at 212°	217,744 lbs.	166,866 lbs.
Hp developed	621 hp.	483
Hp boiler rating per contract	500	500
Hp overload above builders' rating	24%	....
Coal consumed per hour per hp	3.7 lbs.	5.1 lbs.
Efficiency of boiler and furnace combined	81%	61.7%
Factor of evaporation	1.188	1.222

of a recent economy test, however, are interesting and serve to emphasize the possibility of actual economy in tonnage of coal.

Economy resultant from use of stokers, as shown above, increased evaporation by use of stokers 25 per cent, with increase in efficiency of 20 per cent.

Special attention is merited for the item of unburned carbon in the ash in hand firing. This drops through the grates and represents also partially burned coal removed in cleaning.

As an instance also the economy of burning slack coal, stoker fired, against run-of-mine, hand-fired, the following figures are significant:

	Hand Firing.	Stoker	
		Economy Test.	Capacity Test.
Steam by gauge	101.2	101.09	99.24
Kind of coal	Pittsburg	Pittsburg	Pittsburg
Size of coal	Run of mine	River slack	River slack
Total quantity consumed	13,500	10,500	12,300
Total refuse	1,668.5	997	531
Total combustible	11,831.5	9,503	11,769
Equivalent from & at 212° F. per hr.	11,344	12,653	15,600.03
Equivalent from and at 212° F. lbs.	6.72	9.640	8.877
Hp on basis of 34½ lbs. equivalent evaporation per hour	327.8	360.7	452
Builders' rating, hp	120	120	120
Percent increase of capacity by the use of stoker	...	11.6	37.5
Percent increase evaporation per lb. of coal as shown by the stoker over hand firing	...	44.5	32
Cost of evap. water, 1,000 lbs., cts.	4.87	2.85	3.11
Percent of saving by the use of stoker	...	41.4	36.1

Fuel being a large item of steam plant operation, any device that will enable the steam plant to save from 10 to 20 per cent on the fuel bills deserves consideration.

Some Features of Condenser Installation and Operation.

The question of the correct design and installation of condensing apparatus has attained greater importance than ever in connection with the operation of steam-driven units, especially turbines, and since it is of timely value to all power users, whose attention may never have been especially called to this very important part of the modern steam plant, the following notes on some phases of condenser operation, furnished by the Allis-Chalmers Company, may be of interest:

Condenser installations require great care in design, if they are to meet the actual conditions existing at the place where the condensing apparatus is to be installed, and consequently power users who contemplate putting in condensers should make a close study of these local conditions. If they are not themselves fully qualified to pass upon the subject, it is advisable for them to consult an engineer who thoroughly understands condenser applications. The matter is too important to hazard a guess, for there is nothing about a plant which can cause more annoyance than a poorly designed condenser installation. For example:

The greatest care is necessary in the design, construction and maintenance to keep the system free from air leakage; for the chief difficulty in maintaining a vacuum arises from such leakage. The leaks are inward, therefore invisible and hard to locate. The designer or the constructor often does not realize all that is here implied, judging from the results sometimes produced.

There are, in addition, a number of points to be observed, which, if carefully followed, will save an endless amount of trouble and lead to substantial economy in the operation of the plant.

The application of two or three coats of elastic paint on clean surfaces will eliminate many of the leaks in the exhaust pipe lines, but there still remain several places for air leaks which are not so easy to remedy. The stuffing boxes on the rods and exhaust valve stems of the low pressure cylinder are apt to be sources of trouble. This, however, can easily be eliminated by using double metallic packing on both rods and valve stems, and piping the steam from the receiver to the space between the two sets of packing, thereby forming a steam seal on the rod. With such a seal it is impossible for air to leak into the system through the stuffing boxes.

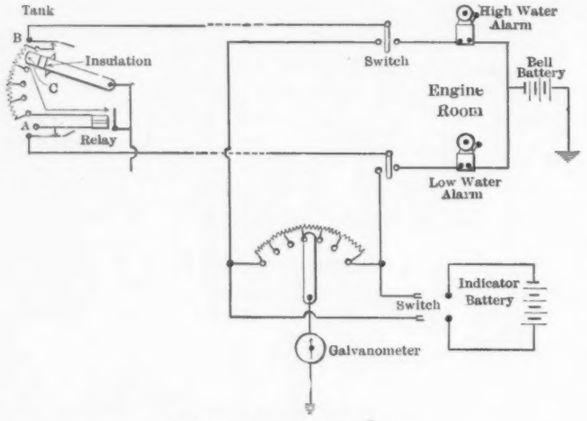
Another source of air leakage into the condensing system is through the water supply. The stuffing boxes on the pump should always be sealed with water, and all joints on the suction line must be made up tight. The line should be carefully painted before burying it in the ground. The higher the suction lift, the more care should be exercised in this work, because all air drawn in through the suction line, which is subject to vacuum, is discharged directly into the condenser. The fact that the pipe may be buried several feet under ground does not protect it from air leakage.

A further source of air being drawn into the condensing system is with the water through the suction line of the pump. All suction lines should be submerged not less than six feet and more if possible. The end of the suction pipe should be increased to at least twice the diameter of the pipe to reduce the velocity of the water entering the line. In a well 12 feet in diameter, a 12-inch suction line was run to a centrifugal pump. The end of the pipe in the well was submerged 8 feet, but not increased in diameter. It had been observed that dry sawdust, thrown on the surface of the water, was sucked in small eddies down into the suction of the above pump. If sawdust was drawn down, it is clear that air was drawn with it. The amount of air coming down the tail pipe of the barometric condenser, discharging into the hot well, showed plainly that there was air leakage somewhere in the system, but the source of it was not located until the action of the water in the well was discovered by the engineers in charge of the plant. The remedy for this condition was to enlarge the diameter of the suction pipe in the well.

LETTERS ON PRACTICAL SUBJECTS.

INDICATOR FOR WATER TANK.

Since water tanks are usually located on the roofs of buildings or at some point distant from the engine room, it is necessary to equip them with some sort of indicating device which will show when they are full or empty. The generally accepted apparatus for this work consists of a simple two-point switch connected with a chain and float which in closing either circuit rings a bell in the engine room. While this device will indicate the predetermined high or low water level of water in the tank it cannot be readily adapted to show intermediate levels, so that the engineer cannot tell whether the tank is nearly full or



INDICATOR FOR WATER TANK.

almost empty. The accompanying diagram indicates an arrangement for a high and low water alarm which by means of the auxiliary apparatus can be used to determine the level of the water in the tank with a reasonable degree of accuracy. A pivoted arm at the tank carries on its end an insulated brush which wipes a series of contacts similar to those on a rheostat. A relay is provided between contact *A* and the next succeeding contact, whose function is to close the circuit between the brush, *C* and the lever, *D*. Between the other contacts are placed resistances of a value equal to that of the relay. Two lines are connected with the points *A* and *B* and a third wire to lever *D*. If the tank is located at some distance a ground connection may be substituted for the wire leading to the lever *D*. In the engine room the apparatus consists of two ordinary alarm bells, a galvanometer, a rheostat similar in resistance to that of the rheostat at the tank, a resistance coil being substituted for the relay, and suitable switches and batteries. The operation of the apparatus is as follows: The switches are set so as to place the high and low-water alarm bells in circuit. Assuming that the tank is filling, the lever, *D*, will be drawn around by the float in the tank as the water rises until it strikes the strap key, breaking the circuit from *D* on high water and grounding it. This will cause the high-water alarm bell in the engine room to ring. A similar action takes place when the water has reached the predetermined low-water mark in the tank, the low-water alarm bell ringing. Should, however, the engineer desire to ascertain how much water the tank contains, or in other words, what depth of water is at his disposal, the bells are disconnected from the circuits and the double-pole switch is thrown, placing the indicator battery on the lines. The current from this battery has two paths, the rheostat in the engine room and that at the tank. In passing through the tank rheostat, the current actuates the relay, thereby grounding *C* and forming a Wheatstone bridge. It is now only necessary to move the lever of the engine room rheostat until a balance is obtained on the galvanometer. The point at which the lever in the engine room stands is then the same as that of the tank, and knowing the ratio of float movement to lever movement at the tank, the depth of water is obtained. A graduated indicator can of course be attached to the rheostat in the engine room so that the depth of water in feet can be read at once. For tanks that are quite a distance from the engine room this method is fairly accurate, as the resistance of the lines can be compensated for, and a poor contact at *C* will not introduce any errors in the indication. Normally the switches would be thrown so as to place the high and low-water alarm bells always in circuit. This scheme is in line with the one suggested in your Questions and Answers column some months ago, and both are much simpler than the scheme published in the December number. Throughout the country there are many small pumping stations, etc., whose engineers are depending on pressure gauges for knowledge of the height of the water in the tank or reservoir, and since many of them oftentimes have some leisure time they might care to construct the apparatus.

New York City. J. W. Strippel.

BRUSH SETTING ON RECTIFIERS OF ALTERNATORS.

In connection with my previous communication on the above subject published in the November number, I would state that when the brushes of rectifiers are first filed and set they do not get a good bearing until after a run of a few hours, and it is better when retrimming brushes to commence early and refit one in each set at a time, as then there are brushes always with a good running fit. This would prevent sparking such as would occur with the first setting. It will be noticed that the negative brushes have to be fitted oftener than the positive brushes and also wear out sooner. I have used a complete set in this manner, filing the positive brushes but twice. We were once troubled with bad cutting of the collector rings which were very soft. The trouble was remedied somewhat by using woven wire brushes and eventually cured by using German silver leaf brushes which ran very well. I have gotten more satisfaction from the old T.-H. straight wire incandescent brushes known as No. 1 than from any others and have found that very low resistance brushes give the best results on the commutators of alternators. Woven wire brushes if properly fitted and taken care of are suitable and do not cut as much as the old T.-H. No. 1 incandescent brushes. In any event the brushes should be watched and not allowed to cut the commutator and much trouble will be prevented.

Patchogue, N. Y. Henry Mulford.

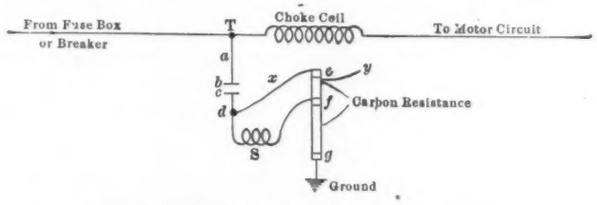
BREAKING WATER-GAUGE GLASSES.

Water-gauge glasses frequently break, seemingly without cause, but there is a cause, and never a glass broke yet without some very good reason. One fireman had a very bad record for breaking glasses. Hardly a day passed but one or more glasses were broken. Finally the writer, having kept a very close watch upon the movements of the fireman, found that the glasses were broken by too frequent and too prolonged blowing out of the water column. A dozen times a day that fireman would open wide the drip at the bottom of the column and let the steam and water rush forth to the full capacity of the three-quarter-inch valve in the drip pipe. The sudden change of temperature was too much for the water-gauge glass to stand. It simply could not respond quick enough to the sudden changes of temperature caused by the inrush of hot steam and water from the boiler into the comparatively cold glass, hence it broke. This also explains why a thin glass lasts much longer than a thick one. The thin glass can respond much more quickly to expansion.

Baltimore, Md. Samuel L. Brown.

OPEN CIRCUITS IN LIGHTNING ARRESTERS.

It is important that a gap arrester have in it one open circuit —the air gap itself—but it is equally important that neither the lightning-discharge path nor the after-current path include an open circuit due to fault. The diagram gives the scheme of connections of a successful arrester much used. Normally, trolley current cannot pass through the device because of the air gap, *b-c*. A lightning discharge will jump the gap, however, taking path *T-a-b-c-d-e-f-g* to the ground, taking section *e-f* of the carbon resistance in preference to passing through inductive blow-out coil, *s*. The trolley current which follows the discharge takes path *T-a-b-c-d-e-f-g* to ground, preferring the low resistance blow-out coil to the high resistance carbon section *e-f*. This trolley current passing through the blow-out coil projects across the air gap, magnetism that repels and stretches the arc until it breaks. So much for operation under normal conditions. If either wire running to the arrester is disconnected or cut, as they frequently are by motormen to get rid of a ground, the arrester is useless. An open circuit in *x* or *y* or between them places the blow-out coil in series with the path of a discharge and lessens the likelihood of its using the arrester as a bridge to earth. An open circuit in *S* does not impair the effectiveness of the arrester as a lightning diverter, but since it cuts out the blow-out coil, the arc will not be ruptured until burning has practically annihilated the air gap and rendered the arrester useless for protection against future discharges. A break in section *f-g* of the carbon resistance increases the effective length of the operating air gap and may render the arrester useless. Inspection of a large number of several kinds of arrester in use



OPEN CIRCUITS IN LIGHTNING ARRESTERS.

for years without inspection showed many carbon rods broken, some with and others without evidence of burning; numerous blow-out coils open circuited either in the coil, its leads or their connection to the posts. Air gaps from 1/16 to ¼ in. Connections of the trolley and ground wires loose and burned, and in some cases these wires cut, pulled loose or burned loose entirely. On many cars the path to and from the arrester had about the same number of turns as the choke coil.

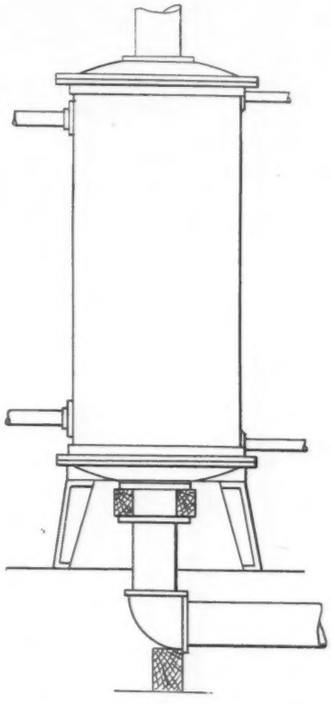
BROOKLYN, N. Y. HENRY SCHLEGEL.

PIPING A FEED-WATER HEATER.

The closed feed-water heater that was used in my plant for a long time has finally been taken out and a new one installed. About 15 years ago the old heater leaked badly, and the engineer then in charge reported that a new one was required. It was not supplied at once, and when another man took charge of the plant he claimed that the old heater was not worn out, but only required packing to make it available for further use. This was done, making the heater good for 15 years as above mentioned. He made an important change in the handling of this heater, which went far towards securing its long life. It was formerly customary to close valves in the feed pipe line on both sides of it at night and leave them closed until after the engine was started on the following morning. The consequence was that after standing all night water in the heater was much cooler than during the day. When exhaust steam passed through it in the morning the resulting heat caused the water to expand, and as no outlet was provided the pressure rose to 180 lb. as plainly shown by a gauge which he connected into the feed pipe.

After trying this experiment he always opened at least one valve in the feed pipe before starting the engine, consequently excessive pressure was avoided. It is always a good plan to keep a gauge on the feed pipe as it quickly indicates any obstruction between the pump and the boiler.

While talking about a new heater the superintendent proposed to put a tee in the feed pipe near the boilers, and connect a branch pipe into it through which water could be conducted to the wash room, thus giving the employes the benefit of hot water. This I opposed because it provided an opening in an important pipe that I could not control.



PIPING A FEED-WATER HEATER.

I advocated the purchase of a double coil heater, and my plan was adopted. It is shown in the illustration, with inlet and outlet pipes for the boiler feed on one side, and the same for the wash room on the other. This enables the shop hands to get hot water whenever the engine is running, without interfering with my water level.

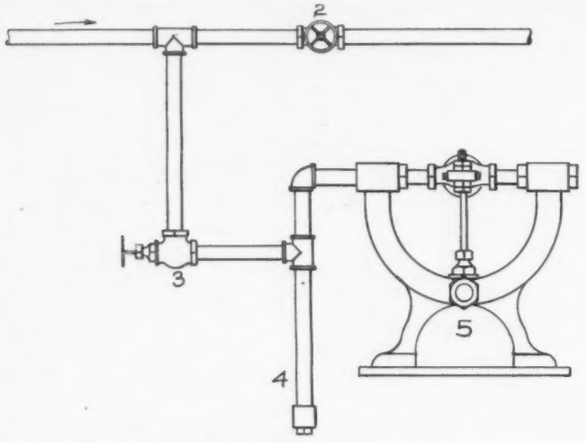
When the new heater came we arranged matters so as to install it without shutting down the plant on a working day. As the new heater was quite different from the old one, and was to be located in a different place, the exhaust steam piping had to be remodeled. It was laid out and the several pieces cut to what we supposed was correct lengths, on Saturday, but when the work was nearly finished on Sunday I found that the piece which must come up through the floor was too short. A new nipple could not be secured that day and I was anxious to start up the next morning; therefore, I cut a thick wooden gasket, and put it between the two flanges as shown below the heater. Of course the studs were not long enough to allow the nuts to go on, but by supporting the ell below the floor firmly with wooden blocks and allowing the heater to rest on the wooden gasket, it was held firmly in place, making a steam-tight joint that answered the purpose well until another Sunday gave me a chance to put in a longer nipple without shutting down the plant.

NEW YORK CITY. CHARLES SIMPSON.

PREVENTING DIRT FROM ENTERING A STEAM TRAP.

I have several steam traps that are fitted with large bodies into which dirt and scale coming from the inside of pipes and radiators may lodge and remain until removed without doing harm. It is easy to remove the bodies for inspection and cleaning, but two that were purchased recently are of different design, therefore if dirt gets into them it is difficult to remove it.

When piping these traps I took the precaution to arrange the connections so that any dirt that might wash down from other parts of the system would be caught in a pocket, whence it could be easily removed. This is plainly shown in the illustration where hot water resulting from the condensation of



PREVENTING DIRT FROM ENTERING A STEAM TRAP.

steam is returning as indicated by the arrow. The by-pass valve 2 is closed, therefore it flows through the angle valve, 3, which is open, and goes to the pocket, 4, where it is discharged against the tee shown, thus abruptly changing its course. The effect is to cause dirt to settle to the bottom while pure water rises and goes to the trap, 5, only the skeleton of which is shown.

After using this device for several months on a system that had already been used for three years, so that it was only reasonable to suppose that the internal surface of the pipes was clean, I took out the plug and found dirt packed in the bottom of the pocket about 2 in. deep. There was enough of it to cause much trouble had it gone into the trap. What the result would have been on a new heating system can easily be imagined.

Providence, R. I. Charles Thomas.

PECULIAR MOTOR GROUND.

Ordinarily, with two motors controlled by a series parallel controller, the current path on the series notches is as in Fig. 1. Here the current passes through one motor, then through the other to the ground. In passing from series to parallel there take place changes effective in so modifying the connections as to give an independent ground connection to the motor that is electrically nearest to trolley and an independent trolley connection to the motor that is permanently connected to the ground by grounding its field terminal to the motor frame. The parallel connections are indicated in Fig. 2. A glance at Fig. 1 indicates that a ground toward the negative end of the No. 1 field, as indicated by the dotted line g, will cut out part of that field, and will also cut out the No. 2 motor; but the car will start and operate on the series notches provided the ground fault does not cut out too much of the field winding of No. 1, thereby leaving it with insufficient torque for starting. Furthermore, since the fault ground is located approximately at the point where the independent ground will be applied to motor No. 1 on

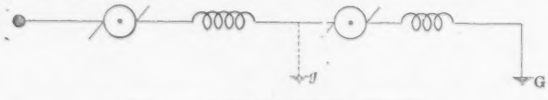


FIG. 1.—PECULIAR MOTOR GROUND.

throwing the controller to parallel, on doing this apparently both motors will work normally, but really one motor will be taking more current than the other owing to the fault ground cutting out some of the turns of its field winding. In the case of a four-motor equipment, the car starts normally with two motors in series and two in parallel, motors 1 and 3 constituting one pair of two in parallel and motors 2 and 4 the other pair. On throwing to parallel the two pairs are placed in parallel, thereby putting the four motors in parallel across the line. A ground toward the negative end of the field winding of either the No. 1 or No. 3 motor will cut out the 2 and 4 motors in series, but the car will start on 1 and 3, which get a ground through the fault. On going to parallel the car will act as if

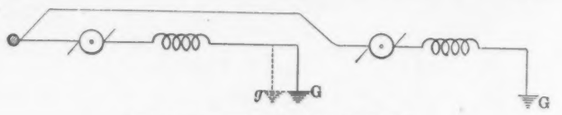


FIG. 2.—PECULIAR MOTOR GROUND.

nothing were the matter, although the weakening of the field of one motor by the fault will cause that motor to take a current excess depending on how much of the winding is cut out by the fault. The possibility of such a condition suggests the importance of some test that will prevent a car from leaving the shop with a field ground on the No. 1 motor of a two-motor equipment, or the No. 1 or No. 3 motor of a four-motor equipment.

New York City. Edward Chilton.

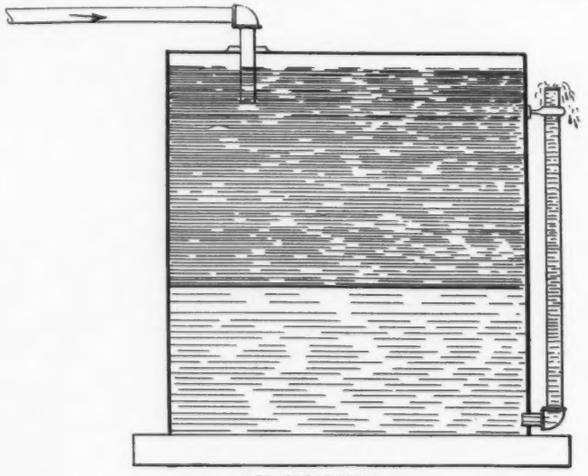
AN OIL SEPARATOR.

As only the best oil available is used to lubricate the engine in the plant of which I am in charge, I try to save as much as possible of it that it may be filtered and used over again. The frame of the engine is trough-shaped, thus catching all oil used on the crank pin, wrist pin, guides and piston rod.

I connected a pipe into the lower part of this frame for the purpose of conducting the oil into a square can set under the floor. This caught the oil, but it also received water that dripped from the piston rod stuffing box, and this went to the bottom of the can; consequently, when I emptied it, only water came out, as the oil had run over the top and disappeared.

As this was not satisfactory I put a pipe into the side near the bottom, as illustrated, and continued it up nearly as high as the top of the can. Now, when water comes to the can it goes to the bottom as before and when it rises high enough some of it enters the pipe. After the pipe outlet is covered nothing but water enters it, therefore the oil remains in the can. In due time oil floating on top of the water causes the latter to run out of the pipe, and this will continue as long as the engine is in operation.

The illustration shows oil standing nearly to the top and



OIL SEPARATOR.

water going to waste. Obviously oil will not go out so long as water alone reaches the pipe outlet, therefore as the supply is continued oil occupies more and more of the space. When about one-half full of oil the can should be emptied before the oil line descends to the outlet, or about once each month in my case. When making this device care should be taken to keep the top of the outlet pipe about 2 in. below the top of the can.

Jersey City, N. J. Willis Johnson.

INSTALLATION OF COMPOUND-WOUND GENERATORS.

My attention has been called several times to mishaps in connecting direct-current machines for parallel operation which were due to lack of thoroughness in almost every case. One finds it ncessary, sometimes, to set up a new machine and connect and start it without the manufacturer's blue prints and directions, and in nearly every case unless due care is used, trouble will result. If all the machines are of the same make there is less probability of trouble, but if of different makes there is always some uncertainty as to the actual conditions.

After a new machine has been assembled, all circuits run, the brushes nicely fitted and the machine started, it may or may not build up, and even if it did there is no indication that it is right for connection in parallel with the other machines until some tests have been made. Therefore, it pays to make sure that one is right before proceeding. The polarity of the other machines and also of the bus-bars should be determined and also whether the series coils are in the positive or the negative side of the system and whether their action is cumulative or differential. In the case of most generators the series winding is in the positive side and the action is cumulative.

Upon starting a new machine after testing all circuits and connections for continuity, if it fails to build up, the first thing usually done is to reverse the shunt circuit connections and the machine builds up. But as to whether in any case this is the right thing to do, even though effective, depends upon subsequent tests which should always be made. If these tests show that the polarity is correct and the series coils are in the same side of the system as those of the other machines and their action proper, as in Fig. 1, then after a proper adjustment of the voltage it can be thrown in parallel with the other machines; but if not the connections must be rearranged.

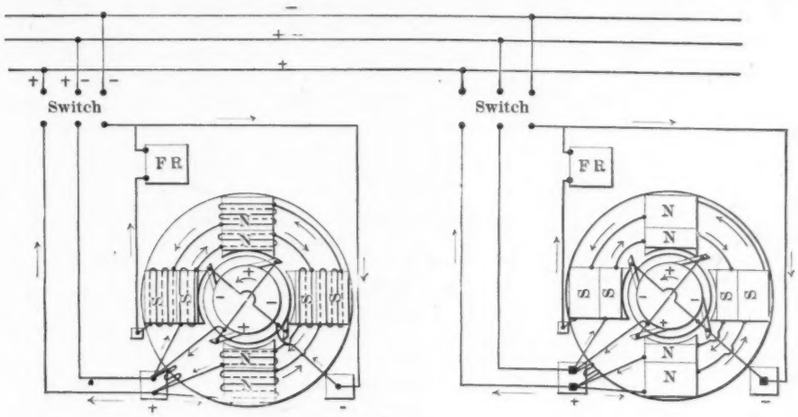


FIG. 1.

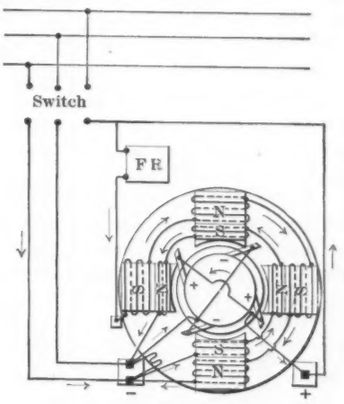


FIG. 4.

If the machine builds up and it is found that the series coils act properly, but are in the wrong side of the system, this can be corrected by reversing the polarity of the poles by disconnecting the shunt circuit and connecting it for a moment to bus-bars of proper polarity and then connecting them up again as before. It will then be found that the series coils are in the proper side of the system. If it is found that the series coils are in the right side but act differentially then some care must be exercised in making the correction. As the relative positions of the shunt and of the series coils and terminal blocks and connections are fixed by the design of the machine it is not necessary to change them, since if everything else is right they will be also.

If, for instance, as in Fig. 2, the series coils are in the positive side, but act differentially, the first thing to do is to reverse the polarity of the poles as already explained, which will put the series coils in the negative side, as in Fig. 4, and their action will still be differential. Then on advancing or bringing back the brushes, which is possible in some machines, or changing the brush leads to positions of opposite polarity and connecting up the shunt circuit and obtaining connections, as in Fig. 3 which are the same as in Fig. 5, the machine will build up and the series coils will be in the right side and their action will be cumulative.

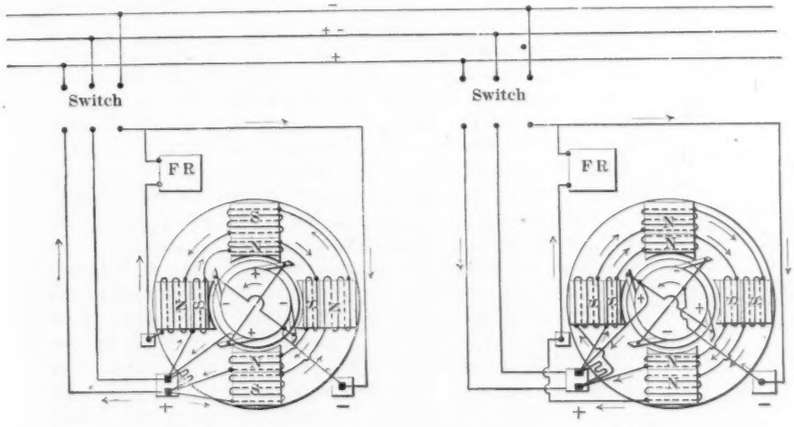


FIG. 2.

FIG. 3.

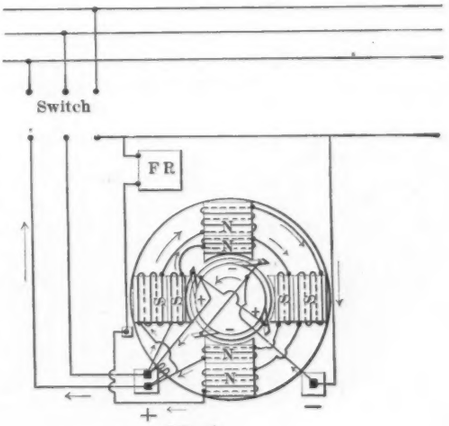


FIG. 5.

If it is found, as in Fig. 4, that the series coils are in the negative side and act differentially, the polarity of the poles need not be changed; but the correction made by advancing or bringing back the brushes or changing the brush leads to positions of opposite polarity, when upon reversing the shunt field circuit and obtaining connections, as in Fig. 5, which are the same as those in Fig. 3, the series coils will be in the positive side and their action will be cumulative.

It is possible in some belted machines to reverse the direction of rotation and thereby obtain the same effects as advancing or bringing back the brushes or changing the brush leads to positions of opposite polarity. It is here assumed that the machines are direct-connected and their direction of rotation fixed by that of the driving engine.

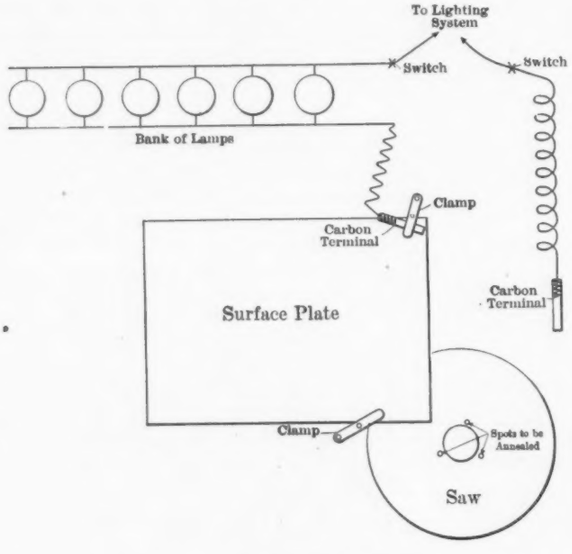
The action of the series winding can be found by putting a fair-sized, separate and constant load on the machine and disconnecting and connecting the shunt strip or short-circuiting the series winding several times while at the same time noting the indications of the voltmeter. If the voltage rises when the shunt strip is disconnected or the short-circuit around the series winding removed, the action is cumulative, and if under the same conditions the voltage falls the action is differential.

PATCHOGUE, L. I. HENRY MULFORD.

ANNEALING STEEL BY MEANS OF THE ELECTRIC ARC.

I have read the Practical Letters department of your paper for some time with a great deal of interest, and while your correspondents have touched many phases of the business, I have seen no communications pertaining to the use of electricity in the machine shop, and in the hope of eliciting some good "kinks" in this line I will describe a little home-made device that has proved very useful to me.

I had a milling operation that required the use of a 4-in. saw 1/16 in. thick very close to a projection on the work, so it could only be supported on one side. Making a special arbor, I turned a shoulder 1/32 in. longer than the saw was thick and soldered the saw in place; but the heat of the solder made the saw buckle and it would break loose after milling a few pieces. Then I decided to anneal the center of the saw and fasten it onto the end of the arbor with button head screws, and after several attempts with the gasoline torch succeeded in cracking the several saws on which the work was being done. Then I began to experiment with the electric arc. An appliance had already been fixed up for a different kind of job, consisting of two pieces of arc light carbon connected up to our lighting



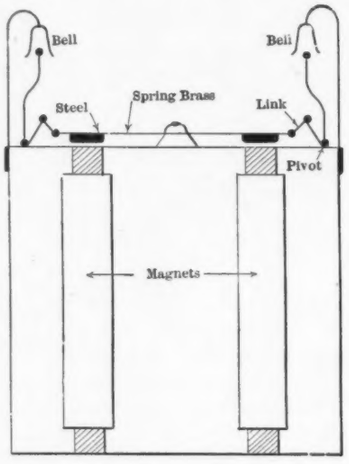
ANNEALING SAW BY MEANS OF ELECTRIC ARC.

system, which was 110-volt direct current, with a bank of six 16-cp lamps arranged so one or more could be put in circuit for resistance. First the spots to be annealed were marked on the saw, which was then clamped by one edge to a small surface plate. One of the carbon terminals was also clamped to the surface plate and turning on the current the other carbon was held just far enough from the spot to be annealed to cause a good arc. This was continued until the spot was judged to be hot enough and then the other spots were treated in the same manner. The result was so successful that the saw was easily drilled and countersunk at the annealed spots and the screws let in flush with the side of the saw. This time the work was finished without further trouble.

EAST GREENWICH, R. I. L. L. ARNOLD.

IGNITER INDICATOR FOR PRODUCER GAS ENGINES.

The producer gas engines in our plant have igniter panels located at the four ends, each panel having two magnet coils, and it was the intention of the party installing them to use a low-voltage incandescent lamp as an indicator; but our experience showed that this threw too much resistance on the



IGNITER INDICATOR FOR PRODUCER GAS ENGINES.

igniter system. Different ideas had been tried and some worked fairly well, the object of the indicator being to determine whether or not the two igniters were working or were grounded. When the two points of the igniter touched, the lamp would glow, and this should take place on each explosion stroke. When the points were separated by the spring on the igniter the lamp would be extinguished; but if the igniter was grounded the lamp would glow continuously. As it was quite important to have some sort of indicating device to call the attention of the attendant to the trouble when it occurred a lighted lamp or some sound was the only safeguard. The following arrangement was finally placed in service: On top of the board was placed a piece of wood, as shown between the two magnets, and pivoted on this was a thin strip of spring brass on each end of which directly over the magnets was soldered a small block of soft steel. Small bells were connected as shown and the striker was pivoted and linked to the brass as indicated. This part of the mechanism was made thin and vibrated very easily. When the circuit was closed by the igniter points touching, the steel blocks were attracted by the magnet and this movement caused the hammer to strike the bell. When the igniter points were separated the spring brass would draw away the steel pieces in such manner as to cause the hammer to strike the other side of the bell, so that the bell was kept ringing as long as the igniter was working properly. In case of a short-circuit or ground, however, the magnet would hold the steel blocks and the bell would no longer ring, so that the attention of the attendant was immediately called to this condition. This arrangement was better than that using the low-voltage lamp for two reasons: it did not introduce so much resistance in the igniter circuits, and made a better indicator since it was necessary to keep an eye on the lamp in order to see if it was working properly, whereas with the ringing arrangement this is not necessary as the attention of the attendant is attracted as long as he keeps within hearing distance.

CAMBRIDGE, MASS. W. A. DOW.

QUESTIONS AND ANSWERS.

Is there any reason why 14-carat gold could not be used with just as good satisfaction for contacts as platinum? E. & Co.

Platinum, or better still, an iridium-platinum alloy, forms the best contact because of its indestructibility, extreme rigidity and hardness. Pure gold is too soft, and the alloy is affected by nitric acid which is formed by the spark usually present when the contact is broken.

It is necessary for me to do a certain amount of work in the shape of plans and specifications for wiring buildings for light and power. I would like to study the matter and prepare myself to do better work in this line. Is there anything in print giving special requirements of specification writing whereby I may check up past work and make good in the future? H. R. B.

Read Merrill's "Electric Lighting Specifications."

Are there any means of utilizing the broken pieces of arc lamp carbons? E. M.

Grind the pieces to a fit and paste them together under pressure, using a mixture of water glass and powdered carbon for the purpose. The resistance of the carbon is only slightly increased by this means and if properly done the joint will be stronger than the rest of the rod.

Kindly advise me if it is possible to locate metals in the ground by means of electricity? H. A. E.

The ohmmeter has been successfully used for this purpose. Two metal stakes are driven well in the ground and the resistance of the earth between them measured. A metaliferous vein has a low resistance as compared with that of dry earth, and by moving one stake the direction of the vein may be accurately located.

Will you please give me a formula for a good commutator compound? C. M.

A drop of pure mineral oil rubbed over the surface of the commutator or a touch of vaseline applied on a piece of clean cotton cloth is all that is necessary. One may take it for granted that the manufacturer has built a machine so that it works sparklessly with the brushes applied, if it does not so work compounds will not be liable to help matters any.

Is there an alternating-current motor manufactured at a reasonable price which will start under full load under the following conditions: A paint mixing machine requires 60 hp to operate it and the machine is shut down at night with the mill full of paint. It is required to start this in the morninge O. C.

Polyphase induction motors are now operating under worse conditions so that there is no question of their being able to operate the paint mill; in fact, for such work with paint dust floating in the air this type of motor has advantages not possessed by any other motor.

Will you please let me know the best color of electric lamp to use for office purposes. The lamps now in use have frosted aluminum reflectors and are at the center and top of the desks. J. A. F.

The best lamp to use for desk lighting in the way mentioned is a frosted-bulb incandescent lamp. The center of the desk is not the best position for the lamp, however, as it is better to have the source of illumination at the left to avoid reflection or glare from the paper to the middle of the desk. For further information on desk lighting see article on "The Lighting of Desks," by Cravath and Lansingh, in the May issue.

I connected the lead of a direct-current armature into a commutator of 96 bars. The armature is lap wound. There are 12 cross connections in the commutator so when the cross connections are all in there are seven bars between the cross connectors. Of what use are these and would the machine run without them? C. P.

The connectors mentioned are what are known as equalizer connections. They serve to equalize any difference of pressure there may be in the e.m.f's of the different branches before the current reaches the brushes and thus prevent the excess current of any stronger branch from flowing through the brushes and so interfering with the commutation. It is safe to assume that these were put on the winding of necessity and that the machine therefore will not operate as well without as with them.

I have a school building to rewire which has seven bells in different rooms, the bells being controlled by separate buttons. It is desired to ring all seven bells at once from a single push button and not interfere with the separate control of each bell. How can this be easily done? E. J. N.

Run an individual wire from each push button to its respective bell and use a common wire to connect the other contacts of all the push buttons to the battery and the other contacts on the bells are similarly connected to the battery. This will give separate control at a minimum expense. Provide a separate and special push button fitted with eight contacts arranged so that a metal plunger will make contact with all eight at once. Connect each push button with a contact on the master button and connect the common wire from the buttons to the battery to the eighth contact. This requires only a few feet of wire in addition to the special button, which may be easily made.

Kindly enlighten me on the following: The smooth-croe drum armature of one of our generators having been removed from the machine for the purpose of truing the commutator, was resting on the floor beside the machine preparatory to being replaced. An attendant carrying a pail of used machine oil in passing on his way to the oil filter stumbled over a piece of shafting near by, spilling the contents of the pail over the armature. Before the latter could be moved a large amount of oil had been absorbed from the floor as well as that which fell directly on it. I understand that machine oil, especially that black with dirt, is injurious to the insulation so that I have not considered it advisable to put the armature in place again until something has been done. On account of its size and the voltage for which it is wound, the cost of rewinding will be quite heavy. Could not the armature be allowed to soak in something which would dissolve and remove the dirty oil and then be allowed to absorb some insulating compound which would make it practically as good as it was before the accident? L. C.

A single dose of mineral oil would not be liable to injure seriously the armature of your machine, and after it has been completely dried out the dirt may be blown away by an air blast. The commutator is more likely to be damaged by the oil than the winding, since the oil lodging in the mica would carbonize in time and thus short-circuit the segments. Why not test out the armature and commutator for faults? Possibly none exist.

Can the single-phase, series-wound commutator motor and compensated repulsion motor, the former having a compensating winding also, run at any speed independent of the frequency; that is, the speed is not prescribed by the frequency as in the induction motor which cannot run above synchronous speed. What motor would you recommend for alternating-current circuits that will give a large starting torque and variable speed? J. C.

Neglecting minor modifying effects which are due mostly to the short-circuit by the brush of a coil in which inactive e.m.f. is generated, it may be stated that the speed of a compensated repulsion motor or of the compensated single-phase series motor is independent of frequency. The compensated repulsion motor commutates almost perfectly at absolute synchronism and sparks badly when the speed is very much in excess of this value. The compensated series motor commutates practically the same at all speeds. Either of these motors can run at a speed very much in excess of synchronism; but for very high speeds the compensated series motor is preferable to the compensated repulsion motor. It may be of interest to state that the compensated repulsion motor draws a leading current; that is to say, acts like a condenser at speeds above synchronism, while the series motor draws a component of lagging current at all speeds. Either motor gives a very large torque at starting and its characteristics are similar to those of the direct-current series motor. A general recommendation as to the selection of an alternating-current motor for variable-speed work cannot be given. The selection will depend largely on the work which the motor will be required to do.

CENTRAL STATION SALE OF CURRENT

Good and Bad Electric Signs.

By Carmelita Beckwith.

Few things in New York have changed more in the last twenty-five years than its sky line. The four-story building has become twenty-four and everything architectural is equally altitudinous; but the sky line I have in mind is not that which greets the eye by day, but that which when darkness has fallen, stands out anew in lines of fire.

Paris has been called the "city of light," but it lingers in mediæval gloom compared with Manhattan Island after business hours. New York is but typical of that development in electric lighting which followed the evolution of the electric sign, and we are going through a barbaric, transitional period. We shall soon learn that all that glitters is not good. Any one who looks at the "Great White Way" to-day must be at once startled and dismayed at the extravagant misuse exhibited there every night of one of God's greatest gifts to mankind. At this moment there is a justifiable outcry all over the country against the defacement of landscape and scenery by hideous signs and advertisements. Even legislation has been invoked to check the outrage. It might well be asserted that the success of the Pullman car system is due to the fact that so many people travel at night to dodge the advertisements along the lines. I venture to predict that at an early date similar reforms will be insisted upon in our methods of electric sign advertising in the cities. At present it is all unsystematic, incoherent and unrelated, one sign differing from another sign chiefly in brilliant ugliness and in trying to down it with a louder glare. In the long run scientific methods, good taste and business economy will prevail, and electric lighting managers should be the first to "blaze the way."

There are so many signs—good and bad—but everybody believes in them. Electric signs are the newest thing in the field, and that is why possibly so many are crude and in a measure fail in their purpose, that of bidding for publicity at night from afar. Some of the signs in New York City remind me of the newly rich; they are so gorgeous and lavish in display, the glare of their light being seen for blocks. Not before the passerby reaches the sign can he distinguish what it says. It may be that this passerby is the only one the merchant wants to catch, but why not let the pedestrian on the cross streets also know the story? This applies especially to the signs on the side streets, which are designed to interest persons traveling along the main thoroughfares of the metropolitan city.

Fig. 1.—The Latest Display Sign in New York City.

Fig. 2.—The Longest Electric Sign in New York City—A Well-balanced Example.

One shining example in New York City is the Fleischman florist sign just off Fifth Avenue. It is such a glare of light you cannot see what it is all about until you stand close to it. This is surprising, too, in the case of Mr. Fleischman, for he has had so much experience and success in attacking the public eye. No doubt his electric adviser is at fault, and that if he uses 4-cp lamps, with a smaller sign, the result would be perfect.

On the contrary, the artistic sign of the De Dietrich Motor on Forty-fourth Street, is plainly legible as far as it can be seen. This was made by Strauss & Company, who are trying to educate people to erect signs that are artistic, fulfilling their purpose during the day as well as at night. All the lamps in the Strauss signs are placed under and shine through, perforated screens, or colored glass.

Central station men may encourage the use of large candlepower lamps, in their desire to dispose of all possible electrical energy; but is there not another side to it? If a storekeeper finds that to advertise his wares at night as well as during the day he can use a 2 or 4-cp lamp in a sign, thus saving energy, will he not be more ready to adopt a sign. And in the aggregate increased use of signs, will not the expensive "peak" be reached more quickly with large lamp units?

Naturally, there are signs and signs. The Studebaker sign, on the roof of that company's building on upper Broadway, is one of the finest in New York City. Eight-candle-power "Downward" lamps are used, and because the letters are 10 ft. high and are perched at a towering elevation in the sky, it is perfect. But I am talking about the every-day man's sign, the man who has but one little store and is obliged to comply with the city law and not allow his sign to project over 4 ft. from his store front. It is simply a question of proportion.

There are many problems in signs beyond the province of the electrician, but those go to make another story. To-day the standard achievement in "set" electric signs is that of the Gold Seal Champagne on Herald Square, New York City. It is beautiful. Everybody turns to look at it and admire. It will be a long time before it becomes an old story, even to New Yorkers who see it every night. That, I believe, is the beginning of a new era in display signs. Four-cp lamps of various shades are used, and the sheet iron frame in which the lamps are set is painted to portray the green leaves and purple grapes. Its beauty cannot be gauged from a photograph or engraving; it must be seen. The Gude Company is receiving the thanks of everybody, including members of the critical Municipal Art Society.

The longest and most striking electric sign in New York—the one illustrated—stretches along the whole block between Forty-third and Forty-fourth Streets at Times Square. Nearly 2,000 4-cp lamps are used in telling the city that the advertiser believes in sweetness as well as light. His depots are all closed at night, but the electric signs are attracting business to keep his people all busy next day.

A good, strong dignified sign is that telling about Garden City Real Estate at the "bow" of the Flatiron Building—for in certain lights the building does look like a great big ship, especially as one is walking southward, down Fifth Avenue. The Metropolitan Engineering Company prides itself on this piece of work, because the story can be read for blocks up and down Twenty-third Street, Fifth Avenue and Broadway. When the store architecture fades on the night, that of illumination should become just as effectively structural, and not be a confusion of crossfire.

Visitors coming to New York from the West—where signs are used in great lavishness—say they are disappointed in the "Great White Way." They all assert that their own city makes a much better showing. We allow that perhaps it does, but at the same time I might draw attention to the fact that Broadway is only a fragmentary part of our sign constellation. There is the great East Side, where many of our New Yorkers are strangers, where even the smallest store boasts its "free sign," and every emporium or department store is fairly ablaze with signs—in Yiddish, Greek, Italian and in other commonplace New York dialects.

One Hundred and Twenty-fifth Street also rivals the Broadway centres; a store there without a sign is almost the restful exception. Then in the Bronx, which is all new, the electric sign looms up in concentrated glory. Were it not for the blaze of light from the big and numerous signs, Brooklyn streets, in the throes of the new subway digging, would be desolate, indeed. Here in Greater New York, in fact, are several Chicagos and Denvers, Berlins and Dublins, which are likely to be overlooked by the visitors and even by the unthinking resident on Central Park West.

Electrical signs are so generally accepted now, that it is amusing to know that in 1887 Mr. Neumuller was told he could not outline the arch of the outside doorway at the famous "Hungaria" in Union Square. He knew it could be done, and the lamps to-day are set in the same construction he built nineteen years ago, the first outside incandescent lighting ever done in this city. Mr. P. G. Gossler, then a budding engineer, built for Thorley, the first electric sign installed in New York City. It certainly proved a success, for Mr. Thorley has been using it ever since over his flower store, and Mr. Gossler has moved on to conquer other worlds of electricity.

I wonder that more people who advertise on blank walls do not follow the example of the New York Edison Company, by having signs that are movable. In the early stages of construction the sign might be attached to the wall of the adjacent building; then as the new edifice advanced, the sign could be moved. In this way, the story is ever before the public. It is mere advertising suicide when a fine hand painting on a broad expanse of wall is gradually submerged by the growing construction of the new building. It is such a waste of golden opportunity, for the sign, of necessity, only lasts at the greatest three months, whereas if a movable sign were used it would be "alive" and fresh for a year. Then after the special building in question is completed, the sign wholly or in part could be moved to any other location where building operations were under way. In New York, which fortunately will never be finished and dead, such a sign could be in working order indefinitely.

Some of the churches are adopting electric signs. Why should not more of them bring their location and vocation to the attention of the public? Their doors are always open, ready to swing inward, and this should be announced both day and night. A sign or illuminated bulletin board is especially inviting in their case, because many churches are hidden away in the cross streets. The magnificent new Grecian structure of Dr. Parkhurst's church on Madison Square is tastefully lighted inside and out. The lighting behind the columns in front of the building brings them into bold but soft relief, making the east side of Madison Square a perfect picture on misty evenings. One can well believe looking at it that within is balm and rest for the weary, even if the pastor is throwing searchlights on the police.

Of course nobody yet pretends to know everything about electric signs, but everybody knows good publicity when he sees it, and I repeat, that many of the signs in New York City defeat their own ends by too much self-advertisement. They would say more if they shone less.

Electric Cooking at Grinnell, Iowa.

Mr. O. K. Cole, manager of the Grinnell Electric & Heating Company, reports that the company has connected and under contract ten electric cooking outfits on separate meters. Half of these have been in use for some time. As stated in an article on page 288 of the ELECTRICAL WORLD of August 11, 1906, on the work of this company, a rate of 4½ cents per kw-hour has been made on heating and cooking service. Grinnell is a town of about 5,000 population and has no gas plant. It is a question whether it will ever need one if Mr. Cole keeps on pushing electric cooking as he has started. The rate of 4½ cents is, of course, down very close to cost of production plus distribution and fixed charges for a small station, but this rate has been made on the theory that it is mainly non-peak business and that it is much better to load up a plant with this kind of business than to have it very lightly loaded during the day with a big steam heating system to supply. There are 215 electric irons in use in the town, of which 100 were introduced during the past summer.

The Organization and Conduct of a New Business Department, Suitable for Central Stations in Cities of 50,000 Population and Under.

The following are some of the points brought out in the paper on the foregoing subject presented in competition for the Co-operative Electrical Development Association prize by Mr. Fred D. Sampson.

The executive head of the "New Business" department will be known as the sales manager. He should have direct supervision of the sales of electricity,—the sales force and the advertising. The sales force or solicitors should comprise young men preferably with college educational training and of local social connections, the personal element being quite a potent factor in the solicitation and promotion of business. These young men should understand the technical talking points of the product they expect to sell—it's multiplicity of uses—and the approximate consumption of energy of electrical apparatus that may be connected to the company's mains.

There are always to be found in the cities of this class, young men with technical training who have been apprenticed to some of the large manufacturing concerns, anxious to obtain the opportunity of furthering their experience by entering the service of a central station organization. Young men of this character would prove invaluable in this department, for the reason that their electrical training would make them familiar from the start with the technical features of the subject; and, furthermore, with factory or shop experience they would be versed in the actual construction and performance of all classes of electrical apparatus, filling the dual position of salesman and engineer. In addition to the technical sales force, a young man should be employed for the clerical work in the office. Some stenographic experience would be necessary in this position. With the increasing volume of correspondence a young woman stenographer could be added.

The campaign should be opened with a direct appeal in the form of a return postal card to every desirable householder. Names of such can be obtained in telephone and city directories, both of which give full address and occupation—information difficult to get through other sources. Thus a complete alphabetical arrangement of proposed customers is procured in the simplest manner. Using a card system, the name of each person with address, date and kind of literature mailed would be filed alphabetically. Sufficient information could be kept upon this card to arrive at the exact status of each person addressed, whether promising or not. This card for filing would be made out simultaneously with the first edition of mail matter sent. In this manner a complete record could be kept. The sales manager and sales force would all familiarize themselves with the mailing list. The city divided into districts could be canvassed by the technical sales force directly following inquiries or at regular intervals.

Newspaper advertising is too costly to be used in addressing a class; it should be a non-partisan medium to secure the attention of the masses. Properly carried out this form of advertising is of the best. The many forms of monthly bulletins or electric service booklets, illustrated, are probably the nearest approach to the ideal advertising that has been devised.

These attractively worded and illustrated bulletins are more generally commented upon when sent through the mail than any other form of advertising; they are really works of art. Distributing by mail is a great advantage over the house to house or hand distribution, a much larger proportion reaching their destination by this method of delivery. The bulletins also thus escape association with the "patent medicine" and "fire sale" literature.

Street car advertising has not been extensively exploited; however, it would doubtless prove an estimable addition to the various systems of advertising inaugurated.

An innovation could be introduced whereby all electrical contractors of unquestionable financial responsibility in the city would be furnished energy free, provided that they would carry a line of electrical specialties for lighting, power and some heating, and display them in a prominent location. This would be of mutual benefit and limit the quantity of display apparatus carried by the central station. It would not be irrelevant to remark that the less stock in direct competition with the electrical contractor the central station carries, the more business it will do with correspondingly less outlay.

The duties of the staff of the new business department would be in a measure dependent upon the urgency of the specific cases requiring its attention. The routine or regular work would comprise a consultation each morning with the sales manager, discussion of unfinished business and planning of future work. For the convenience of the assistants the business and residence districts could be reduced to a map in sections printed on public service cards shaded by the solicitor to represent territory covered each day with an epitome of results noted on the reverse side. Thus the area canvassed at any specified time could be ascertained at a glance. Upon the receipt of inquiries by mail or otherwise, acknowledgement should be made, stating time representative would call for interview.

All employees of this department should be placed upon a salary basis, commensurate with their worth and to the locality. Commissions might be considered; although the equity of same is very questionable, unless solicitors were changed from time to time to equalize the advantages of canvassing in power districts.

Sale and Handling of Domestic Electric Appliances.

At a meeting of the Association of Electric Lighting Engineers of New England, held in Boston, Nov. 21, Mr. J. E. Davidson, general manager of the Consolidated Lighting Company of Montpelier, Vt., presented a paper with the above title, in which the subject was treated from the standpoint of a community having a population of from five to twenty thousand. An abstract of the paper is printed below.

The central station manager who desires to interest the community he serves in domestic electric appliances is advised, as a first step, to take care that both he and his subordinates are thoroughly familiar with all the different devices and their component parts, and are equally well posted as to the cost of operation of the same, separately and in combination. The mere knowledge that such articles as culinary utensils, heating pads, cigar lighters, curling iron heaters, etc., etc., are being manufactured and put upon the market is not enough; he must know all about them, the bad points as well as the good ones; how they compare in cleanliness, adaptability, reliability, efficiency, durability, safety and economy, with competing appliances, where alcohol is the heating element; and, in the case of the electric kitchen, comparing it with the gas stove, or the use of coal or wood for fuel. Have an air heater in the bathroom, heating pad, vibrator, curling iron and long distance Hylo in the bedroom, a cigar lighter in the den; have a motor-driven sewing machine and washing machine; and last, but most important, an electric kitchen outfit. The manager of a central station should be quoted as authority on this subject, throughout the locality with which he is connected, from his actual experience, so that the appliances may be placed with the guarantee of his actual knowledge regarding them.

There is no question whatsoever but what the electric kitchen has come to stay, and together with the flatiron it makes an excellent load for the lighting company. All realize how hard it is to fill in the noon hour gap, and it looks as though we were going to be helped out right here. In placing the electric cooking appliances, at the start, it is going to be a repetition of the gas stove proposition; the buyers will be families who are well-to-do. This class of people, as a rule, have their noon-day meal at twelve-thirty or one o'clock, thus giving us a load

of from one to three kilowatts at a time when our current is of least value. And it helps out doubly on Sundays and holidays, the meals being more elaborate on these days, and the consumption, therefor, greater than usual, at a time when practically everything else is shut down. The only drawback is the cooking of the evening meal during the winter months, when we have our heavy lighting peak; this is not such a rosy situation.

Among the appliances for the electric kitchen are the gridiron for pancakes and toast; the broiler, which cannot be equaled for cooking steaks or fowl, without burning, or losing any of the delicate juices, which are caught in a dish placed at the end of the broiler; the oven, which, having a perfectly even heat, gives unparalleled results for the baking of pastry and the roasting of meats; the cereal cooker, which undoubtedly is the most useful of any of the utensils, on account of its adaptability, as it can be utilized for steaming eggs, cooking cereals and vegetables, steaming puddings, etc., etc. The waffle iron also fills its requirements to a nicety. On the disc stoves any dish can be heated that would ordinarily be placed on the lid of a coal stove or over the burner of a gas range.

Every lighting company should have at least one electric kitchen, connected with it, where records are accurately kept, in diary form, on the cost of different kinds of meals, for families of various sizes, the cost per person per day, the total cost per month at different rates per kw-hour, etc., etc. If there is more than one in company using a kitchen outfit, by comparing notes, you can accumulate data that will be of the greatest value. Employees should be encouraged to use the appliances, and they will be twice as enthusiastic when it comes to soliciting or making a sale.

The coming spring will find the culinary utensils perfected, and from that time rapid strides should be made in their installation. Mr. Davidson states that it has been his practical experience, that in order to get satisfactory results, a rate of 4 or 5c per kw-hour will have to be given, preferably the former, and even in some rare instances a rate as low as 3c. Otherwise, you cannot hope to compete with the rates usually allowed for fuel gas. The question What does it cost? is a very broad one, and can only be answered when it is determined how many there are in the family, their style of living, and above all, is the cook careful. In cooking by electricity, the cook is like the fireman in the boiler room—the whole thing when it comes to cost. You may say the same thing is true with gas, but it isn't. Current is left on appliances when they are not in use, just because there is no wasted blaze to prick their consciences; and again, "high" or "medium" heat will be used for long periods when perhaps low heat would do just as well. Therefore the manipulator must keep her eyes on the indicating switch and use common sense, just as the fireman must watch his fires, drafts and gauges. The consumption per person per day or per month is bound to be a curve dependent entirely upon the above mentioned conditions. Mr. Davidson's experience in cooking by electricity altogether since May 1st, for a family of three or four, living as we central station managers have to, is that the consumption is about 1 kw-hour per person per day, or thirty kw-hours per person per month. As to baked beans New England will lose its national reputation for this dish, if they are cooked by electricity. An oven running for ten hours at medium heat consumes 1,000 watts, and as some cooks urge that twenty-four hours' baking is necessary for their perfection, I fear they would be an expensive luxury.

Some of the most convincing arguments to use to a prospective purchaser of an electric kitchen outfit are as follows:

First, that by its use and only by its use, the temperature of the kitchen remains the same as that of the rest of the house.

Second, the economy of space, as the table on which the utensils set takes up very little room, and can be utilized for other purposes when cooking is not in progress.

Third, the rapidity with which a meal can be prepared. No coaxing of fires, just turn on the current. When dinner is late, the old excuse "the fire went out" won't go, but I suppose a new one will soon take its place—"the current was shut off."

And best of all, its cleanliness in comparison with any other means of cooking. There is no smoke, you can keep the finish of the kitchen just as fresh as that of the living room. There are no ashes to take care of. This certainly saves lots of wear and tear on the nervous system, for is there anything more irritating than to be the ash man? There is no stove to black every day, and you have no idea how far this will go in keeping the maid good natured.

The best way to accomplish the sale of single appliances to any number is to choose some article that is not expensive, either in initial or maintenance cost, and start a vigorous campaign. First, advertise, in the local papers, with electric signs, by means of pamphlets and bulletins, and, if the right chance turns up, with some novelty ad. Next, whether your campaign be on flat irons, heating pads, sewing machine motors, culinary utensils, or something else, there should be a neat and attractive display in your show windows, and in your office or display room, such a demonstration as will convince the public of the merits of the article. In demonstrating the heating devices, it is always a good plan to have something cooked; for instance, serve coffee from the electric coffee percolator; or waffles, which can be easily and quickly made on the waffle iron, and are inexpensive; so that everybody who comes in can be invited to have something to eat.

After the advertising and demonstrating have thoroughly aroused the interest of the community in the article in question, the next move is to get it into your customers' hands. Competent solicitors should have this in charge, and every residence customer visited. The device should be fully described, and before leaving, it should be properly connected and tested, to make sure that everything is all right. In the case of the flat iron a thirty days' trial is usually given, but with other appliances ten days should be sufficient. In about a week therefore, the solicitor should again call, to ascertain if the appliance is working to the housewife's entire satisfaction. In this way you can find out whether it is being allowed to prove its good qualities or not, and if not, perhaps a further effort will accomplish its trial and final purchase. When the ten days are up, the solicitor makes his final round, and either takes the device or its equivalent in cash. If the device is retained, complaints must be carefully followed up, and repairs made when necessary. We have found, however, that the appliances need very little attention after they are once properly installed.

The flat iron, of course, gives the best results, as a campaigner, as it is more generally known than the other appliances. Therefore, it makes a fine starting wedge. Then, gradually work into, say, pint or quart water heaters, pancake griddles, or maybe an electric pad. Don't burden the customer, but get a few appliances into use, so that their many advantages may be noted, and little by little more interest is awakened, sewing machine and washing machine motors are inquired about, and, finally, you have brought about a situation parallel to that of electric lighting, "Once used, always used."

Don't forget to tell the customer that electric appliances eliminate the minimum charge bugbear entirely or to a great extent, as they are used the most during the period when a certain percent of the bills don't reach the minimum, and the consumers think they are paying for something which they haven't had.

There is no question but that the right aim is to get the customers already on our lines to use more electricity. This is far better than a new customer, as it eliminates the cost of connecting, in the way of labor, line material, transformer and meter, and additional office cost, in keeping of books, records and the reading of meters, and best of all, you don't get transformer and other losses, and thus increase the load factor of your whole plant.

The electric vibrator is becoming very popular in the household, now that most of the makes are past the experimental stage. There is no question of their superiority to hand massage, and many will be sold for use in the bedroom or bath-

room. The heating pad has innumerable advantages over the hot water bag. It is so light, so flexible, it won't leak; the temperature is always uniform, and it is perfectly sanitary, as the eiderdown cover can easily be removed and washed.

A quarter or half horse power motor, properly installed, for running a washing machine, or perhaps a small ice cream freezer, is a welcome adjunct to a residence equipment. In these days of scarcity of domestic help, there is nothing that will solve the washing problem like a motor back of the washing machine. It will get help when apparently there is none in sight. A sewing machine motor is almost a necessity, as it is a well-known fact that running a sewing machine for any length of time is injurious to the health. By means of a motor, too, twice the work can be accomplished in a given time.

One of the latest inventions is a corn popper, of ordinary size, made with a short handle, and run on two rubber rollers, which will pop the first batch of corn in nine minutes and the second in four or five. There is also in use, I understand, a combination folding wash basin. Dental sterilizers are quick heating devices, much appreciated by the dentists.

The heater manufacturers must be complimented on the neatness and lightness that the heaters have been worked down to. A thousand watt heater can be easily carried about by anyone. Some sort of handle might be attached to the top of the heaters, as now it is quite impossible to move them when they are hot. It must be borne in mind that these heaters can only be used intermittently; it is folly to advocate their sale for general heating, even if the energy was sold as low as one cent per kilowatt-hour.

The atmosphere at this time seems to be well permeated with ideas of standardization. Now that the electric heating business is beginning to get its growth, the manufacturers should get together on this point. It is extremely annoying to find, upon taking an appliance from one room to another, that the plug that was used in the dining room will not fit the receptacle in the bedroom, and so on. There must be uniformity in this respect, if the heating appliances are ever to have the place they are entitled to. The makers must co-operate in the way of receptacles and plugs.

If there is no display room, a display of heating appliances should be arranged in some corner of the office, with plenty of pamphlets and bulletins near at hand, so that when people come in to pay their bill or on some other business their attention may be attracted to the devices and an opportunity furnished for a little talk on the subject and to provide them with pamphlets, containing descriptions of the articles. Appliances should be sold as near actual cost as possible. Sacrifices have to be made in every good cause, and surely there is no better one for central station managers than to broaden the field for the disposal of electric current.

Dont's in Electric Lighting.

In a letter appearing in the Chicago *Daily News*, signed by Ernest Filer, the following advice is given to users of the electric light:

Don't let the office boy or any one else who does not understand make changes in electric wiring or lights. They may do the very thing they ought not.

Don't pull a lamp hung by flexible cord to one side with a wire and then fasten to a gas pipe. I have seen a wire become red hot in this manner. If the lamp hung by a cord must be pulled over use a string.

Don't wrap paper around a lamp for a shade. You might go home and forget it and a fire might be started from the heat. Use a glass or metal shade. That is what they are for.

Don't let a socket on a fixture hang loose. Have it repaired. Otherwise it may cause trouble where least expected.

Don't try to save a little by running flexible wires over boxes, partitions, and into closets. Have permanent wires installed. These flexible wires used this way are dangerous.

Don't add a piece of flexible cord to another if too short. Get an entirely new cord.

Don't take any chances with electric wires. Have the work done well and let it alone.

Don't try to cheat the city, the electric company or the wireman and your wires will be absolutely safe and harmless.

Advertising Rivalry at Sheboygan.

The gas company at Sheboygan, Wis., has an advertising space on the Opera House curtain, adjoining which is a space allotted to the Sheboygan Light, Power & Railway Company. One evening the gas company came out with the picture of a prisoner in stripes chained, with the inscription, "Don't Stick to Old Ideas. Use Gas." The next time the advertisement appeared the electric light company's space adjoining bore an enormous hand pointing at the gas advertisement with the remark, "Don't Go to Prison. Use Electricity."

Testing Meters at Peoria.

The Peoria Gas & Electric Company has a very well-equipped electric meter testing department. It keeps in stock all of the ordinary portable testing instruments needed in the work of the company and in addition a Westinghouse standard precision wattmeter and ammeter. The latter instruments are kept in an iron safe in the company's meter-testing room. It is not the practice of the company to bring in customers' meters for the ordinary checking up. The meter tester is provided with a bank of lamps with which he can load the meter when testing it on the customer's premises. A very compact lamp lank is secured by the use of cylindrical or bunghole lamps. The old practice of using indicating wattmeter and stop watch in checking-up consumers' meters in place is being superseded by the use of a General Electric master recording wattmeter, which is a recent type of instrument put up in a portable carrying case having a dial indicating revolutions of the meter shaft. A calibration card carried with the instrument gives the watt-hours for a given number of revolutions and also the watt-hours for a given number of revolutions on the various types of meters on the company's lines. Since this master meter gives directly without the use of a stop watch or indicating instrument the number of watt-hours used during a test, it saves the necessity of sending out two men together to test meters. One man with this instrument now tests from 12 to 13 meters per day, while formerly when an indicating wattmeter and stop watch were used two men together would test about 20 per day. The outfit carried by the two men required a wagon. The master meter and lamp bank can be carried on a street car by one man. It is also considered less annoyance to customers to have one man go in to make a meter test than to have two men. Commutator meters are tested at least once a year and sometimes oftener if in a bad location or if registering a large amount of energy. The company's experience seems to indicate that testing of induction types of meters is not necessary so often as once a year.

Cooling an Ice Box Without Ice.

A customer of the Janesville Electric Company, Janesville, Wis., has hit upon a clever scheme for cooling his ice box during the winter, which may prove of interest to readers. He has a grocery and meat market. To keep his ice box cold without ice in the winter, he has run from the ice box a tin furnace pipe to the outside of the building and has a fan at one end to direct the cold air from the outside into the ice box. In this way he is enabled to keep his ice box cold all winter without any expense for ice.

British Central Station "Business Getting" Methods.

We report the following from our English contemporary, *The Electrician*, which recently has displayed considerable interest in the subject of central station commercial methods:

The meter is a constant source of attraction and might be used to remind the customer that something more can be done with electrical energy than the lighting of lamps. Why not provide a small brass frame into which a card might be dropped by the meter reader each time he calls? The lie-on-your-stomach-and-hold-a-match-at-arm's-length location for the meter would not be conducive to this form of publicity, we know, but in many shops in which the meter board is always in sight it would answer the purpose. This is just a suggestion to be acted upon where meter positions will justify it.

Then there is the meter book or card. Why is this left speechless when it might convey much in a few words concerning the advantages of electrical apparatus? A little more spent on the printing of these accessories would keep the department constantly "talking." Without reducing the sale of electrical energy to the level of the methods adopted by grocers and other tradesmen, the station engineer might do worse than give away a good almanac at the year's end to his best consumers. There is limitless scope for making the design of his gift appropriate, and the station will be assured of effective publicity for the next 12 months. The almanac can be procured at any desired cost, and for even a small outlay a very suitable design may be obtained. If the engineer is in any doubt as to the right course to adopt in this matter, let him set aside the amount he feels he can spend, and obtain estimates and samples to cover that sum. The wording on the almanac should present no difficulty, and if an ornamental border is required for the illustrated matter it can usually be prepared by the printer, who will usually have, or can easily obtain, special material or a selection of designs for this class of work.

In other directions publicity can be secured, such as by means of small pocket novelties shaped like the common articles of electric service. A lamp bulb, for instance, in aluminum or celluloid, with the name of the station and rates for energy on one side and a calendar on the other. An electric motor is a suitable and novel form for making in miniature, and can be made up so as to form a perpetual calendar by revolving the armature. Then there is always the well-known and very popular glass paperweight with an electrical design glued on the base, the always useful blotting pad, and the ever-ready "Memoranda Remembrancer."

These are but a few more of the means at the disposal of the engineer for advertising the service. Half an hour's thought will bring to mind a dozen other little ways in which the commonest accessories of the system can be turned to good account, and—what is most important—at comparatively small expense. Now that publicity departments are being organized for central stations much is being written about the "systems" which should be adopted to smooth out the supposed difficulties confronting those responsible for their conduct. There have been advocates for the establishment of elaborate departmental schemes to bring customers on to the mains. A commercial engineer, a few assistants, one or two stenographers and numerous canvassers are to comprise the staff of the new department, and complicated "clerical machinery" is to be installed, presumably to represent that all-saving term "organization." At first blush this looks very businesslike and convincing. Half a dozen good offices furnished with "system" cabinets, revolving chairs, roll-top desks and daintily carpeted, make a brave show, and it is pleasant to hear the click of the typewriters; but does this bring business? Is there not rather too much of this kind of thing in commercial circles nowadays? We are getting so "card indexed" and "vertical filed" that we really have no time to attend to business.

Station engineers must beware of too much system. It is possible to clog up the department mechanism with it to an extent that half the time of the staff is spent in making and seeking useless records. A note of warning should be raised against so-called "system devisers" for publicity departments. Whether these come as representatives of business organization firms or as commercial engineers makes no difference. They have but an imperfect knowledge of the requirements to be met, and can only advise on the application of certain "methods" to the peculiar needs of the case. The engineer will do far better to commission the services of a good engineer with some commercial knowledge to develop the business side of the undertaking. Such a man will want no assistance at all at the outset, and would scorn the very often useless impedimenta of so-called time and labor-saving systems. When he finds the work too much for him he will consider the question of offices and a certain amount of "organized method." Many of the schemes have involved heavy outlay and constant attention to keep in working order. It is folly to hamper the undertaking with clumsy centralized systems, when the class of work requires something entirely opposite. The details which a commercial engineer needs to have at command are better rendered available by himself than by a clerical staff which can be only equally efficient after personal training by the engineer. The work is too specialized to require elaborate treatment by non-competents, and a good man can always get business without complications of system and over-interference from a central department.

Good use is being made of local exhibitions, which remain open a week or two in a district. These displays of electrical apparatus unquestionably help to make these goods better known, but they do not always carry conviction. An attractive lecture will correct the deficiency and impress the value of electrical energy in a more impressive and lasting way. The public cannot always understand the literature distributed at exhibitions, and this is particularly the case with those visitors who have not used electrical energy at all.

Propaganda work of this kind is very necessary to the popularizing of the electric service, and it can only be effectively carried out by judicious lecturing. There is an abundance of material to work upon. Only a smart lecturer is required, who knows his subject and can "handle" an audience, and a modern lantern with which good pictures can be projected on to a large screen. Booklets can be distributed at the close, and a few instructive electrical manuals might be on sale. Admission should be free. If tickets were issued, application for these could be invited by advertisement or circular. This list of applications could be supplemented by another list prepared at the lecture hall, and would well repay the cost of the lecture, because these lists would be an accurate index to those in the district interested, or likely to be interested, in the uses of electrical energy.

The Denver "Electro-Shino" Parlors.

There was recently opened up in Denver a shoe-shining establishment operated entirely by electricity. Several rotary polishers are provided driven by compressed air. The compressed air is supplied by a compressor driven by a 3-hp electric motor, which maintains 100 lbs. pressure and furnishes air sufficient to operate four rotary polishers in ordinary work. The rotary polishers are very simple in construction and consist simply of a jet of air working against a wheel. Compressed air is also used for brushing clothes, an ordinary brush being used with a jet of air blowing through it. Another novel feature of the establishment is the device for creasing customers' trousers. This consists of a pair of electrically heated tongs which are pushed along the crease after it has been slightly moistened. Customers can have coats pressed with an electric iron while they are having their shoes polished. Mr. L. F. La Mar, proprietor of the establishment, is the designer of the various appliances mentioned. He claims that the rotary pneumatic polishers have an advantage over direct-driven elec-

tric polishers in that there is no danger of burning the shoe if the bootblack applies too much pressure. The pneumatic polisher will slow down if much pressure is applied. The electroshino parlors are located at 1111 17th Street, which is the principal street leading to the Union Depot.

Children as Solicitors.

The Chicago central station companies are offering a set of premiums to boys who secure new customers for the company. By securing new customers is meant getting the prospective customer to fill out an order blank so that a regular solicitor of the company can call and have the usual contract signed. Upon the connection of this customer to service the boy who secured him is sent a premium order redeemable at the advertising department at the company's general offices. The premiums consist of toy electric motors in different forms, one being a motor alone, another a motor driving a small line shaft, another geared to a hoist and an electric car. Children have been used very effectively as solicitors in some other cities.

Letters to the Editors.

Central Station Business Getting.

To the Editors of Electrical World:

Sirs:—I have been following, with a good deal of interest, the central station business-getting suggestions in the Electrical World and various other mediums which have come to me from time to time during the past year. I want to congratulate you upon the excellent manner in which your journal has handled this matter. At the same time, without wishing to use the Electrical World as a medium for criticising others, I want to register a protest against the undignified character of some of the suggestions I have received from other sources.

Surely business can be obtained without resorting to slang and vulgarity! Yet such expressions as "Ginger talks to solicitors," "The Public is from Missouri" and "Get Down to Brass Tacks" bristle all over some of your esteemed contemporaries.

No one would voluntarily send out as a canvasser a man who talked like a race-track tout or a stable-boy. Yet, that is the character of the language used in some of the articles addressed to the central station manager and in some of the advertisements suggested as desirable for him to send to his prospective customers.

As a central station man I resent the idea that one has to be vulgar to make me understand him or to arouse my interest, and I presume one or both of those objects are aimed at by the writer of such rubbish.

Let us have good stuff to send out, let it be put in good plain English, not copied from Ade's Fables in Slang; let us not assume that the consumer to whom we are appealing is uneducated or ignorant; let us remember that the public whom we wish to interest by our circulars and advertising are not the residents of the slums. The people who can be persuaded to use electric light, heat or power are, as a rule, able to understand English; let us stick to it and say what we have to say forcefully and interestingly.

If a man cannot be forceful and interesting without resorting to slang it is his fault, not the fault of the English language; and such a man should not presume to advise others in the matter of "What to say and how to say it."

New York, N. Y. C. S. Mann.

Experience With Tantalum Lamps.

To the Editors of Electrical World:

Sirs:—As our experience with tantalum lamps may be of interest to your central station readers, I give a synopsis of it below:

Since September we have placed these lamps in forty of the business places of this city, in many instances displacing 5-amp., 110-volt arc lamps with clusters of six tantalum lamps. The total number of tantalum lamps in such places now on our system is about 700. One result has been to arrest the spread of the use of gasoline, which had become a serious menace during the summer, and four users of gasoline have returned as customers through the use of these lamps. We have been trying gradually to change from flat to meter rate, and insisted that tantalum lamps could be used only on meter. Nearly all of the forty places were formerly on flat rate and are now on meter, and those who are using tantalum lamps are the best satisfied customers we have ever had. We find that a cluster of six of these lamps will take the place of and be more satisfactory than a 550 or 600-watt arc lamp. Our renewals average this time of year about six lamps per day, or about 2 cents per kw-hour. We charge only 1 cent per kw-hour for renewals, which is too cheap, and I would advise a charge of 1½ cent. We send a boy around each morning to make the renewals, and find we can use a certain number of the lamps again by uniting the filaments.

By making the renewals ourselves we prevent the use of these lamps in flat rate sockets, of which we have a few left. Up to the present time we have not increased our revenue by the use of these lamps, but it has fallen behind very little if any. We have obtained customers with this lamp, that we had not been able to get before. They have made the electric light much more popular and there is much more new business in sight on account of their use. We have been so busy making the changes that we have not felt disposed to encourage new business as yet. There has also been difficulty in keeping a supply of tantalum lamps.

Merrill, Wis. E. S. King,
Secretary Merrill Railway & Lighting Company.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Lamps and Lighting.

New Special Lamps.—An article on new electric lamps. The author first gives a review of the development of the Nernst and osmium lamps, and then speaks of the mercury vapor lamp and especially of its modifications for the production of ultra violet light, using globes either of fused quartz or of special glass composition. The spectrum of the new glass composition called the "Uviol" of Schott attains the wave length of 253 $\mu\mu$, which is quite sufficient, in fact, perfect, for medical purposes, because rays of very short lengths can be neglected on account of their very small power of penetration. The visible part of the spectrum extends only from 579 to 405 $\mu\mu$, and a long range of chemical rays two-thirds of the length of the spectrum are here excluded. In photography the special mercury lamps of Schott (Uviol) and Heraeus (quartz) are excellently adapated for exposures and printing by artificial light in northern climates with their short and dark winter days. These lamps will also be of importance for the textile industry in testing the fastness to light of different dyestuffs. The so-called fluorescent lamp, constructed by Schott, is merely a variation of the Uviol lamp, in which a larger portion still of the long wave rays are suppressed and removed; it burns, therefore, somewhat dully; whilst the exterior and the attendance is the same as for other lamps. In the light of this lamp everything appears pale and unreal. Whilst the lamp itself burns comparatively dull, it produces in its surroundings widespread

fluorescence on different substances, for instance, rhodamine, fluorescein and uranium glass, so that such substances give more illumination than the lamp itself. Vaseline, lanoline, soap, and the human skin also exhibit a peculiar play of color. Since in the latter case changes in the skin imperceptible by daylight become visible, the Uviol lamp is an inestimable medium not only for therapeutic and pathological purposes, but also for diagnosis. The author then refers to the tantalum lamp and states that Siemens & Halske intend to manufacture tools and other articles out of tantalum alloys. The tantalum pen is said to have a great resistance against chemicals, to be much harder and more elastic than the steel pen, and on account of this hardness and elasticity, to be indestructible. It exceeds in elasticity the well-known gold nib of the fountain pen, and so these two kinds of writing pens will soon be supplanted, if metallic tantalum can be made at an acceptable price.—*The Engineer,* (London), Dec. 7.

Calculations of Illumination.—BLOCH.—For street lighting the author has formally recommended the use of the mean horizontal illumination in horizontal plane 1.5 meters above ground as an indication of the quality of the street-lighting system employed. He states that for interior lighting the mean horizontal illumination may be used to advantage in exactly the same way. In order to facilitate the introduction of this conception into commercial use, the author formerly described a simple method of determining the mean horizontal illumination by graphical means. Since, however, a graphical method is not quite as convenient as a purely arithmetical method he has worked out a method of the latter kind and instead of his former curves and diagrams he now gives numerical tables for determining illumination. These tables refer to the most important sources of light used in practice. The paper is to be concluded.—*Elek. Zeit.,* Dec. 6.

Power.

Condenser.—An illustrated description of a new jet condenser, deviced by Leblanc. The main feature is the use of a reversed turbine to drive a spreading jet of water into a cone, sweeping out the air and water vapor, compressing them into the convergent cone and allowing them to expand in the divergent cone, where the velocity is checked and the pressure increased so that the whole is discharged against the pressure of the atmosphere. In the left-hand diagram of Fig. 1 a simple

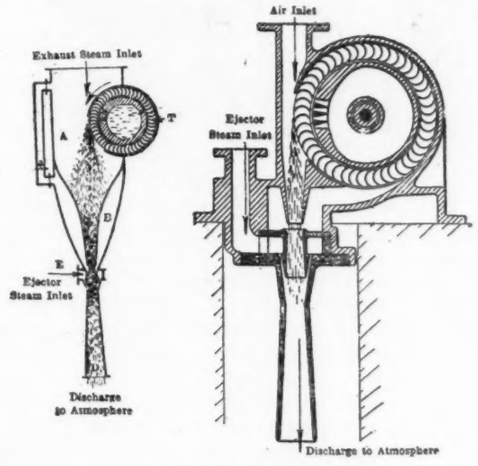


FIG. 1.—CONDENSER.

jet condenser is shown; *A* is the condensing chamber, *B* the convergent cone, *D* the divergent cone, *T* the turbine pump, and *E* the inlet for steam, which is used to start the action of the apparatus. If the water is supplied under a slight head, the condenser starts without the use of a steam jet. With this condenser a vacuum of 98 per cent. of the absolute value can be obtained, using 25 lb. of water per lb. of steam and with an expenditure of power to drive the turbine amounting to 2.5 or 3 per cent of the power of the steam engine. There are no valves at all, and the cost of upkeep is trifling. The right-hand diagram shows a dry-air pump on this system, which takes less power than reciprocating pumps; it is proposed to use this in conjunction with a centrifugal pump for extracting the water of condensation. This device used with existing surface condensers has allowed of an increased vacuum with less mechanical loss. It has also been employed with a centrifugal pump keyed on the turbine shaft, and enclosed in the same cover; the pump extracts the water, while the Leblanc pump deals with the gaseous products. The exhaust steam enters a conical chamber into which the injection water is squirted through a number of holes round the periphery. With this apparatus under good conditions, it is said to be possible to reduce the back pressure even below that of water vapor at the temperature of the exhaust steam.—Lond. *Elec. Rev.,* Dec. 7.

Gas Analysis in Steam Plants.—KERSHAW.—A continuation of his long illustrated serial. In the present installment the author deals with the use of continuous and recording gas-testing apparatus. He explains how to make the connections between the testing instruments and the flues and describes the following automatic testing and recording instruments: Ados recorder, Uehling gas composimeter, the Arndt econometer or gas balance, the Krell recorder, and the Haber-Loewe carbon dioxide testing apparatus.—Lond. *Elec.,* Dec. 7.

Gas for Power.—SCHOETTLER.—The conclusion of his long illustrated paper on the use of gas for power purposes. In the present installment the author gives a review of the evolution of the large modern gas engine.—*Elek. Zeit.,* Dec. 6.

Traction.

British Tramway Accounts.—An abstract of the annual financial report of the municipal tramway system of Bradford. The total cost per car-mile including capital charges, comes out as 22.0 cents against 21.882 cents last year.—Lond. *Elec.,* Dec. 7.

Electric Haulage on Canals.—GERARD.—An article replying to some criticisms of his former comparison of the Siemens and Halske system of electric haulage on canals used with the American system. His comparison was in favor of the latter and he now maintains his former position. The article contains some illustrations and tables.—*Soc. Belge d'Elec.,* Bull. Mensuel, November.

Equipping Cars.—EMANUEL.—Some practical notes on the equipping of cars with electrical apparatus, dealing especially with the clearance to be allowed around trucks, the wiring up of the motor leads, of the lamps, etc., and the installation of rheostats.—*Elec. Jour.,* Dec.

Installations, Systems and Appliances.

Financial Results from Central Stations.—DETTMAR.—A paper in which the author gives some supplementary statistical information on the financial results obtained in German central stations. He has formerly covered merely the small stations, namely in cities below 20,000 inhabitants. He now deals with cities between 20,000 and 100,000, and has found the surprising result that the average financial results are not as good as with cities having from 5,000 to 20,000 inhabitants. In cities with 20,000 to 100,000 which furnish current for traction, the average financial results are worse than in cities with 5,000 to 20,000 without tramways, and only in the real large German cities the average financial result is better than in cities with 10,000 to 20,000 inhabitants. It seems that especially in cities of medium size the tariff for traction current is often too low. Many statistical tables are given.—*Elek. Zeit.,* Nov. 29.

Electric Lighting Installations.—LEBOUCQ.—The purpose of a station manager must be to produce a maximum of light with a minimum of electrical energy. Some calculations are given on the design of lighting network, and the importance of using economical lamps and of controlling the insulation of all house installations is pointed out.—*Soc. Belge d' Elec.,* Bull. Mensuel, November.

Wires, Wiring and Conduits.

Transposition of High-Tension Wires.—While it is the practice on some systems to transpose the high-tension wires at frequent intervals, on others no transpositions at all are made. Throughout all portions of the country practice is about equally indefinite. Those who transpose the wires do so from a theoretical standpoint rather than from actually observing any ill effects in systems where the wires are not transposed. In fact, from an operating standpoint, it is safe to say that the effects of transposition are in practically all instances unnoticeable. From theoretical considerations there is no doubt that when wires are run straight there is an unbalancing or an inductive effect and an extra amount of fuel is required. There are, however, not sufficient data to decide whether this extra amount of fuel would warrant the cost and trouble of the transposition of the wires.—*Street Ry. Jour.*, Dec. 1.

Cables.—Jacquin.—A brief review of the development of the cables used for the distribution of electrical energy, with special reference to American, German and French practice.—*La Revue, Elec.*, Nov. 15.

Electro-Chemistry and Batteries.

Primary Battery.—An editorial on the recent American Electro-Chemical Society paper by Crocker on the Decker primary battery. One of the most likely fields put forward for a battery of this kind is the driving of electric boats and automobiles. Under conditions where there was shaking the output of the Decker battery was 14.7 watt-hours per pound of total weight. This output can be increased by carrying an extra supply of electrolyte so that the battery can be refilled en route, the zincs being sufficiently thick for more than a single discharge. Other advantages are that the battery can, of course, be discharged right down to exhaustion without doing any harm, and that a recharge is not necessary immediately after discharge. "These points might appeal to the automobilist if the electro-mobile were alone in the field. But in country districts, where electric energy is not available, we think the average automobilist would have no hesitation in preferring some form of petrol car." The cost of materials is high and there will also be local action. "This high cost is important; but the factor which probably tells most against the primary battery in cases where it would otherwise be used is the trouble of handling acids and zincs for renewals. In this respect the Lalande cell is as convenient as any in a small way, notwithstanding its low e. m. f., and has the great advantage of negligible local action. The Decker battery may have some points in its favor, but it does not mark so great an advance as is suggested by Prof. Crocker."—Lond. *Elec.*, Dec. 7.

Electrolytic Rectifier.—An illustrated description of the de Faria electrolytic rectifier, as shown in Fig. 2 in the left-hand

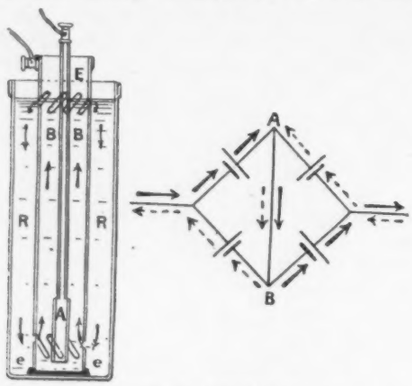


FIG. 2.—ELECTROLYTIC RECTIFIER.

diagram. Each of the electrolytic valves is composed of an aluminum cylinder *A*, within a lead cylinder *B* provided with holes *E* and *e* at top and bottom. These two electrodes are placed in a solution of sodium phosphate (one kilogram of salt for eight liters of water) and contained in a hard-rubber vessel *R*. For the rectification of a single-phase alternating current, four of these valves are connected according to the arrangement of a Wheatstone bridge, as shown in the right-hand diagram. One of the diagonals *A B* represents the circuit in which the rectified current is consumed. During one half-wave of the alternating current, the flow of the current in the different parts of the circuit is indicated by the drawn-out arrows, while the flow of the current during the next half-wave is indicated by the dotted arrows. The formation of the aluminum plates is simple. It is sufficient to connect the apparatus to a supply network together with a rheostat having a resistance of some 20 ohms for a circuit of 110 volts. The current which passes through the apparatus (while the direct-current circuit is open), decreases rapidly. The resistance of the rheostat is then reduced and finally completely suppressed. This formation of the plates has to be carried out only once. When the aluminum electrodes have been formed once in this way, they may remain indefinite in the electrolyte without dissolution of the insulation film. The hot electrolyte rises inside the inner tube and then passes outwards through the holes *E* and downwards on the other side, thus producing automatic circulation and cooling. The cooling effect thus obtained is sufficiently rapid to operate the apparatus with a current density of 8 amperes per square centimeter of aluminium surface, and an apparatus of four electrolytic valves, giving 10 amperes at 110 volts, occupies 90 centimeters in height and 48 centimeters each in length and width. For an apparatus giving 25 amperes, the corresponding dimensions are 60, 110 and 52 centimeters. The efficiency measured by the ratio of the indications of a wattmeter in the direct-current circuit and a wattmeter in the alternating-current circuit, is abopt 60 per cent for the 10-ampere rectifier and from 65 to 70 per cent for the 25-ampere rectifiers.—*La Revue Elec.*, Nov. 30.

Units, Measurements and Instruments.

Lamp Bank Resistance.—Brackett.—An illustrated description of a lamp bank which may be easily sub-divided, being made up in the form of a sectional book case as shown in Fig. 3. Each unit consists of a partially open box, containing twelve lamps, together with a row of single pole, double-throw

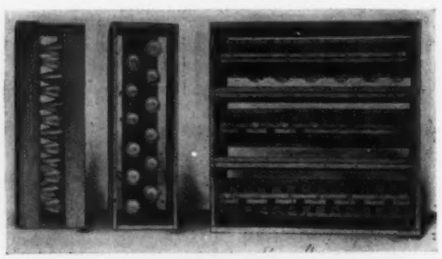


FIG. 3.—LAMP RESISTANCE UNITS.

switches, that will give any parallel-series, or combination grouping of the lamps in a particular box. These boxes may be piled one on the other in tiers. As many tiers as needed may be placed side by side to build up as large a bank as is required for any particular test. The partially open construction of the containing case for each group of twelve lamps, allows perfect ventilation. It gives direct access to the switches. Both the lamps and the switches are completely within the space occupied by their case, so as to be protected from accidental injury. With twelve, 16-cp, 110-volt lamps the minimum resistance is about 16 ohms and the maximum 2,400 ohms. Thus quite a large number of well-graded current values between 6 amp. and .04 amp. are readily obtained. The twelve lamps are connected in a series with a double-throw, single-pole switch at each end and between each two adjacent lamps. When the switches are all open there are no connections from the lamps to the terminals of the box. Closing any two switches in opposite directions connects the one or more lamps between those switches to the terminals of the box. Evidently single lamps or groups of lamps may thus be put in parallel, as conditions require.—*Clarkson Bulletin*, Vol. 3, No. 4, October.

Measuring Deflections.—PIERCE.—An illustrated description of a method for determining the deflections of a mirror galvanometer. The advantages claimed for the arrangement are that it is not easily put out of adjustment after it has been once set up, and that the image of the scale is so large and clear that a prolonged use of the device does not involve the eye strain which most reading telescopes would cause. In front of the plane mirror, *M* (Fig. 4), of the galvanometer, instead of the usual cover glass, is placed a convex lens, *A*, of

FIG. 4.—MEASURING DEFLECTIONS.

focal length equal to the desired scale distance. This lens need not be achromatic; a spectacle lens is quite good enough. At a distance in front of *A* equal to its focal length is placed a horizontal scale, *S*, mounted on a thin strip of wood at least twice as wide as the scale itself. Through the middle of this strip, above the scale, is bored a round hole, *H*, rather more than 20 millimeters in diameter; just behind the scale is stretched a fine vertical wire or silk fibre, to serve as a cross-hair. Behind *H*, and at a distance suited to its focal length, and to the eye of the observer, is placed another spectacle lens, *B*, to serve as an eye-piece. The centre of *H* should lie approximately in the common axis of *A* and *B*. A peephole, *P*, on this same line is placed at such a distance behind *B*—which may conveniently have a focal length of 12 or 15 centimeters—that *B's* aperture shall appear wholly filled with a large, clear uncolored image of the scale, with the wire running vertically across it. The proper distance between *A* and *S* is determined by making the parallax of the wire across the lines of the scale, when the eye is moved sideways across the peep-hole, to disappear; when this distance has once been found, the scale is firmly clamped in position. The distances between *S* and *B* and between *B* and *P* may be adjusted by every person to please himself, though it is usually possible to fasten *P* securely in a suitable position, and to move *B* only to fit the eyes of different observers.—Lond. *Elec. Rev.*, Dec. 7.

Pyrometers.—ARMAGNAT.—After some notes on thermo-electric and electric resistance pyrometers, and on the Féry radiation pyrometer, the author discusses recording instruments and various applications of pyrometry. He finally describes a special pyrometer designed for determining critical points in heating and cooling curves.—*La Revue Elec.*, Nov. 30.

Voltmeter.—SCHUETZE.—An illustrated description of a revolving coil voltmeter, of pocket size, made by Hartmann and Braun with three different sensibilities.—*Elek. Zeit.*, Dec. 6.

Miscellaneous.

Electrical Industry in Continental Europe.—Notes on the annual reports of the more prominent continental European electric manufacturing concerns. Siemens & Halske will pay a dividend of 10 per cent, the Allgem. Elek. Ges. a dividend of 11 per cent, and the Rheydt cable works 15 per cent. The Oerlikon Co. states that the year's trading would have allowed of the payment of a dividend, but it was decided to abstain from any distribution for the purpose of strengthening the financial position of the concern. The United Electricity Company of Vienna pays 5 per cent.—Lond. *Elec. Review*, Dec. 6.

Fuel-Testing Report.—The preliminary report on the operations of the fuel-testing plant of the United States Geological Survey at St. Louis, Mo., 1905, J. A. Holmes in charge. The report contains the following chapters: introduction by Holmes; field work by Parker and Burrows; work in chemical laboratory by Lord; washing tests by Wick; steaming tests by Breckenridge; producer-gas tests by Fernald; coking tests by Belden; briquetting tests by Holmes. The last and longest chapter is a detailed report of the tests of the different coals.—*Bulletin 290 of U. S. Geological Survey.*

Electric Floor Polisher.

For some time past a motor device has been in use for smoothing down marble and perrazza floors, the motor imparting movement to the grinders. A similar device has also been in use for planing off the surface of wooden floors. Both styles of apparatus have been employed on the hallways and room floors of the new building of the United Engineering Societies, taking electrical energy from the Edison mains.

A further ingenious advance in this direction is seen in the patented invention of Mr. Alfred Pongracz, of Losoncz, Austria-Hungary, whose electrical floor polisher in this country is in the hands of Mr. Louis J. Auerbacher, 30 Greenwich Ave-

ELECTRIC FLOOR POLISHER.

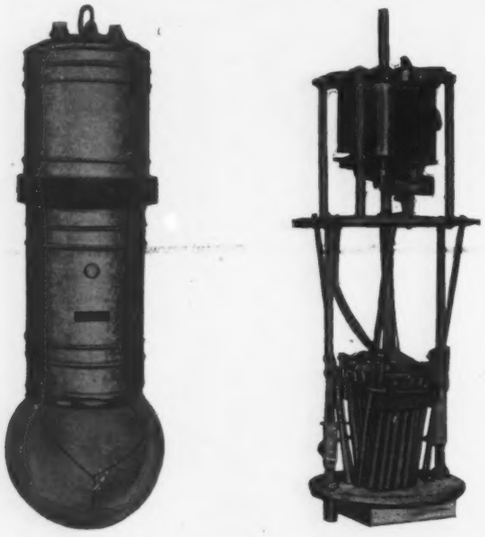
nue, New York City. The apparatus is illustrated herewith in an engraving that shows very clearly the device and the method of operation, subject to sundry improvements that are being made. The apparatus is particularly intended for polishing hardwood floors, but is available also for floors of marble, tile or linoleum. With a hardwood floor, a coating of liquid wax is applied in the usual manner, and the polisher is then propelled over it. Connection being made to any convenient electric light outlet in the room, and the motor switched on, the operator takes the bicycle handles and pushes the machine forward, in front of him. It travels easily on the rollers, and is in reality self-propelling, the handles being merely for steering purposes, as the motion of the brushes causes the forward motion. The brushes are self-cleaning and last indefinitely, and the surface secured is very smooth and even. From rec-

ords kept it would appear that one electric polisher will do the work of ten men and do it better. The current required is equivalent to that taken by three incandescent lamps, so that the consumption of energy is not at all large. As will be seen, there is a double reduction of the motor speed through gearing. It is believed that this novelty will find a ready adoption in hotels, clubs, stores, institutions and private dwellings provided with floors to be cleansed or polished.

Magazine Type Flame Arc Lamp.

The flame arc lamp illustrated herewith is provided with a multiple arrangement of carbons so that it will burn from 50 to 60 hours per trim. The arc is formed at the lower ends of the carbons, being surrounded on each side and above by an "economizer" which prevents the air currents set up in the globe from affecting the arc. The flame is blown out in a fan shape and held in this position by two magnets.

The mechanism for controlling the lamp is contained in a chamber at the top, which is entirely closed off from the rest of the lamp so as to prevent the ash deposits from the carbons coming in contact with this very important part of the lamp. The mechanism is extremely simple and positive in action, yet it allows for a wide variation in the current strength.



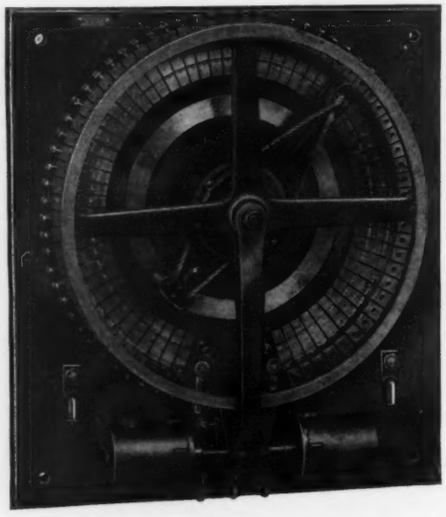
FIGS. 1 AND 2.—MAGAZINE FLAME ARC LAMP.

This type of lamp is built by the Warner Arc Lamp Company, Muncie, Ind. It is supplied for either alternating current or direct-current multiple or series circuits. Each lamp consumes about 320 watts and gives about 3,000 candle power. This company also builds a type of flame arc lamp in which the carbons are placed one above the other and burned in the usual manner; this lamp burns from 5 to 6 hours per trim.

Remote Control Rheostat Switches.

Modern switchboard engineering tends towards making the controlling board as compact and safe as possible. To this end, remote controlled apparatus with low tension wiring at the switchboard has been devised. The accompanying illustration shows a simple remote control field rheostat recently placed on the market by the General Electric Company, to take the place of the motor-driven switch.

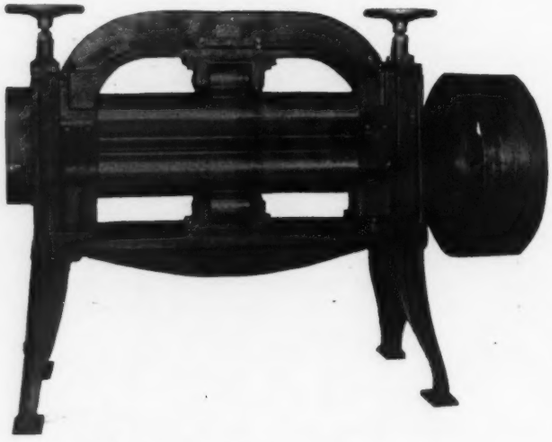
This automatic rheostat is arranged so as to cut resistance in and out of the circuit by a revolving arm making contact on a series of points corresponding to divisions in the resistance. The switch arm is rotated by means of pawls which engage in the knurled rim of a wheel upon which it is mounted. The pawls are operated by a solenoid plunger to which the necessary reciprocating motion is imparted by alternately making and breaking the energizing circuits of the solenoid magnets. A single-pole, double-throw control switch is used to close the circuit in one solenoid or the other, depending upon the direction in which it is desired to turn the switch arm. Limiting switches are provided so that when the rheostat arm reaches either end of its travel, it opens the operating circuit.



REMOTE CONTROL RHEOSTAT SWITCH.

Smoothing Roll for Armature Disks.

After armature discs or segments have been cut in a die it often happens that on one side of them there is a small burr due to the fact that it is almost impossible to keep the die in such condition that it will always make a perfectly clean cut; also the discs are sometimes bent and are not perfectly flat. It is quite essential that the burrs be removed and that the discs be made flat, as otherwise there would be an imperfect contact between the discs, and there is also the possibility that the sharp burr would cut in the covering of the wire which goes around the discs and thus short-circuit the armature.



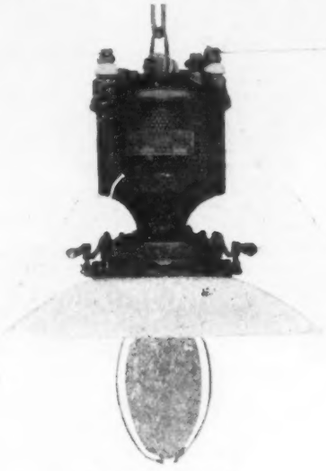
SMOOTHING ROLL FOR ARMATURE DISCS.

To remove these burrs and make the discs perfectly flat and true, the E. W. Bliss Co., 12 Adams Street, Brooklyn, N. Y.,

has for some time past made smoothing rolls. Special conditions have now, however, made it necessary to use much heavier rolls than have been employed heretofore, and accordingly the machine illustrated herewith was designed and built. The rolls in this machine are of chilled iron 8 in. in diameter by 40 in. long, and they are ground true so as to produce a perfectly smooth blank. Proper pressure is brought to bear by means of the hand wheels shown. To prevent the possibility of the rolls springing, they are backed up with smaller rolls as illustrated. The rolls are geared together and the gear wheels are encased to prevent anything being caught in them.

Special Design Short Arc Lamps.

The lamp illustrated herewith has been so designed that the overall length is reduced to a very low value, being only 20 inches from the top of the lamp to the lower end of the enclosing globe. Even with this length, the life of carbons per trim is not materially reduced below that given by an

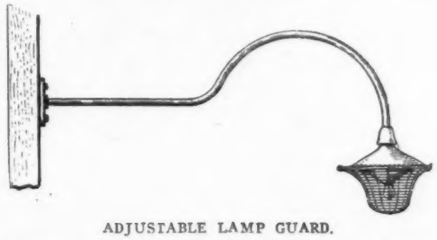


SHORT ARC LAMP.

ordinary 5-amp. lamp. It is stated that a life of 100 hours is obtained. The small dimensions are rendered possible by the use of indestructible windings and specially designed resistance units. Special construction has been adopted in order to secure adequate ventilation, while at the same time protecting the regulating mechanism from harmful accumulation of dust. This lamp has recently been placed on the market by the Western Electric Company, Chicago, Ill.

Adjustable Street Lamp Guards.

An adjustable street lamp guard has been introduced by the Greenwood Manufacturing & Supply Company, of 147 Milk

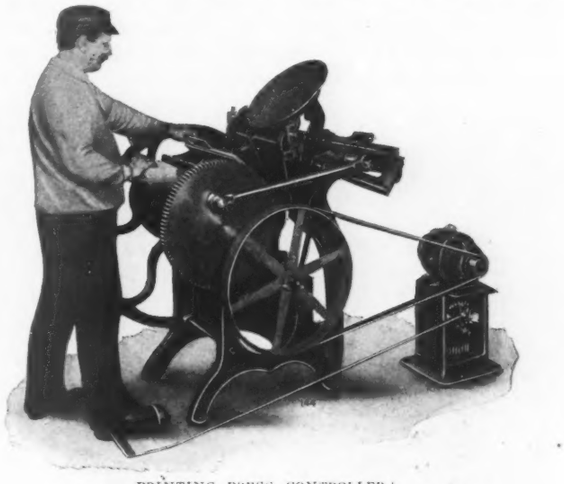


ADJUSTABLE LAMP GUARD.

Street, Boston, Mass. This guard, illustrated in the engraving herewith is fastened to a galvanized-iron band, encircling the shade. It is hinged on one side, with a clasp fastener on the other, thus allowing renewal of lamps to be made instantly. It is made from special hard-drawn steel wire, strongly assembled and so constructed as to give maximum endurance with a minimum obstruction to the light. The guards are nicely galvanized and are guaranteed not to rust. They have been adopted with excellent results by many companies.

Printing Press Controller.

The printing press controller illustrated herewith is operated by a rod and foot lever, thereby allowing freedom of the hands, and resulting in maximum output. The foot need not be kept on the lever all the time, but only when it is desired to change

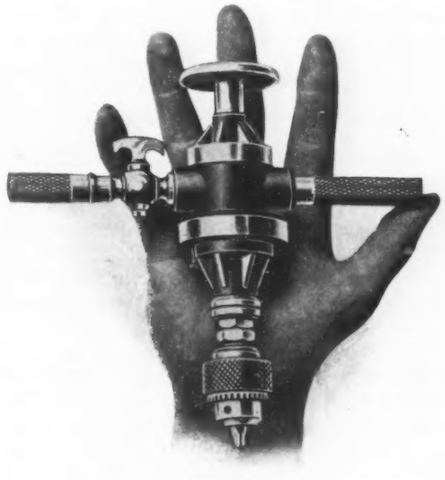


PRINTING PRESS CONTROLLER.

the speed. It will be noted that the motor, controller, switch and fuses are mounted together in a compact unit with a pedestal base. This equipment is manufactured by Roth Bros. & Co., 27 Clinton Street, Chicago, Ill.

Midget Rotary Drill.

What is stated to be the most compact drill ever placed upon the market is shown in the accompanying illustration. The implement is capable of drilling holes in steel as large in diameter as 3/16 in., and yet weighs only 2.5 lb.; the distance



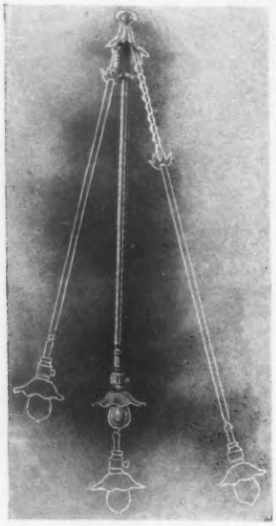
ROTARY DRILL.

from the top of the breast plate to the end of the spindle is 7⅝ in. The propelling motor is of the rotary compressed air type operating at 22,000 r.p.m., while the spindle speed is 2,000 r.p.m. This machine operates at full speed without vibration and is particularly adapted to drilling tell-tale holes in stay-

bolts or general light work, where accuracy is required. This machine has been produced and is being marketed by the Chicago Pneumatic Tool Co., Chicago.

Universal Adjustable Fixture.

A new form of universal adjustable fixture has been brought out recently by the Gail-Webb Manufacturing Company, of Buffalo, and is called "No. 8" by that concern. It is shown herewith. It is intended for use in offices, factories, mills, designing rooms, and other places where it is desired to throw light upon a particular area or object. This fixture consists of a ball-and-socket arrangement secured to the ceiling and a steel rod provided with a brass sliding or extension tube which can be drawn out or pushed back over the rod at will. The



UNIVERSAL FIXTURE.

SWITCH HANDLE.

ball-and-socket permits the fixture to be adjusted to any desired position in an instant.

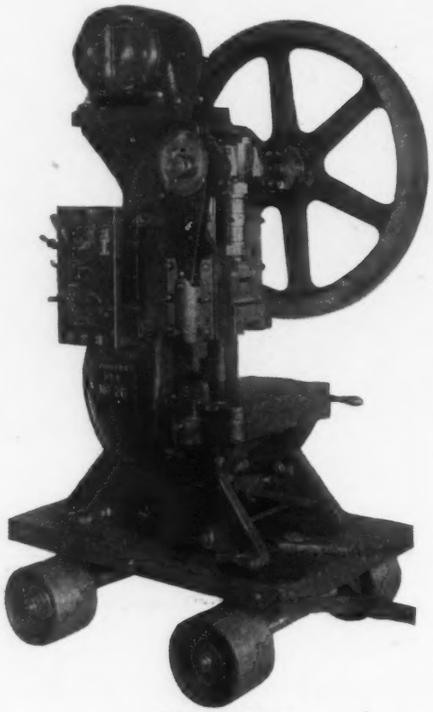
The lower end of the sliding tube is provided with a ball-and-socket clamp to which the lamp can be readily attached and which permits the lamp to be turned to any desired angle. On this fixture the upper part of the wire is coiled around the rod, and as the lamp is drawn down the coil is extended, the cup at the bottom of the coil pushing the wire back to a close coil as the lamp is raised. Fixtures 4 ft. and longer (when extended) are made with an extra large ball-and-socket.

Remote Control for Oil Switches.

The Hartman Circuit Breaker Company, of Mansfield, Ohio, has designed an inexpensive system of distant manual control for use in connection with its oil switches. The controlling means consists of a ¼-in. steel tiller rope, running over pulleys to the operating handle on the front of the switchboard. The switch is installed on the wall of the switch room, or wherever convenient, and the cable can be carried overhead, or through iron pipe along the floor. The accompanying illustration shows the operating handle with the cable brought down from above and along the front of the panel. The handle plate can be mounted at the joint between two panels, thus utilizing a space not available for other instruments. The oil switch is readily operated through a distance of 100 ft. or more, and pulleys are provided for bringing the cable to the switchboard at any desired angle. In the case of automatic switches heavy springs are attached to the cable lever for returning the switch lever into proper engagement with the trigger or catch, after the switch has opened automatically.

Small Motor-Driven Trimming Press.

Conditions sometimes arise in a drop forging shop making small forgings when it is not advantageous to put the small trimming dies in a large trimming press. Moreover it hardly pays to have a small trimming press alongside of each drop hammer. Hence the E. W. Bliss Co., 12 Adams Street, Brooklyn, N. Y., has just designed and built the machine illustrated. It will be noted that it is direct driven by a two-horse-power



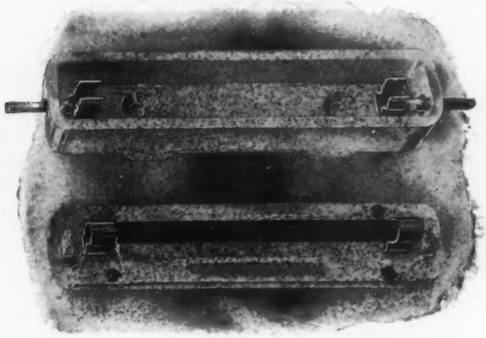
TRIMMING PRESS.

electric motor, the starting box, switch, etc., all being fastened to the side of the press at a convenient height for the operator. To facilitate "range of action" the press is mounted on a truck and it is equipped with wire and contact plug so that it can be readily removed to the desired location and started immediately. A machine of this character must of necessity be operated in an aisle, but to occupy no more floor space than was absolutely necessary the motor was placed at the top of the machine; and in view of the possibility of someone running into it, the truck was made large enough so that the machine does not overhang at any point. The total floor space occupied by the truck is 45 by 39 in., the total height 84 in. and the total weight, including the truck, is 3,000 lb. The press is controlled by the Bliss positive clutch operated by a hand lever.

The Woolley Lightning Arrester.

The proper functions of lightning arresters are well known, and an arrester designed to fulfil these functions and in addition to cope with and counterbalance what is termed the attraction for lightning of the electric current flowing through the apparatus to be protected, is shown herewith. The essential part of the arrester, which is known as "Type C C," (constant current), is a specially constructed rod with very high ohmic but non-inductive resistance, which is inserted between the line and ground without any intervening air-gap whatsoever, so that a constant flow of dynamic current through it to the ground is permitted. The peculiar construction of the rod is such that while it limits the flow of the dynamic current to an almost negligible quantity, it does not impede the lightning discharge, but rather offers a dead short-circuit to ground, which is admit-

tedly the path of least resistance. The rods are homogeneous in composition and are said not to heat or fuse with the small dynamic constant load nor with the sudden lightning discharge. Its resistance is said to be constant under any conditions of operation. The rod is mounted in a strong porcelain box in such a manner that the removal of the cover will also withdraw the rod for inspection, the cover being held in position by spring clips. For outside use the arrester is mounted in a substantial wooden box. Attention is directed to one particular feature of the arrester in that it is capable of taking any discharge howsoever small since it does not have to build up to jump a break in the arrester. The rod is non-arcing and is said to be



LIGHTNING ARRESTER.

indestructible. Arresters of this type are said to have been in continual service during the last two seasons and to have stood very severe and practical tests. The arresters are adaptable for all low-voltage systems, whether alternating or direct, and it is recommended that in power stations one be placed in every outgoing feeder and every insulated return. For line work not less than five are recommended to the mile, and for car work it is suggested to connect one on every car. It is also advisable to connect an arrester to every building entered by wires for better protection. The manufacturer of the arrester is the Woolley Electric Company, Clayton, Mo.

Multiple Scale Voltmeter Switch.

The multiple scale switch illustrated herewith has been designed to meet the demand for a device to render it practically impossible to injure a multiple scale voltmeter by careless con-

VOLTMETER SWITCH.

necting or through ignorance. The switch is placed on the instrument where it is easy to see and operate.

Normally the indicator stands at "open," as shown. Connection is made to the one pair of binding posts no matter what range is wanted, then the button is turned till the indicator points to the range desired and the readings are made. The switch is securely held in position for the required range until the operator is through; then either by pushing a button or closing the lid of the instrument it is released and flies back to the open position. Thus the switch always stands at "open" when the instrument is not in use, and it is impossible to use the low range without connections having first been automatically made to the higher ranges. Consequently the operator is forced to think and see exactly what he is doing, thereby affording the best protection conceivable against carelessness or absentmindedness.

This switch is manufactured by the American Instrument Company, of which James G. Biddle, 1114 Chestnut Street, Philadelphia, is general sales agent.

National Steel Tube Cleaner.

The salient feature of the tube cleaner illustrated herewith is that each blade acts independently of the others and is so spring-like in nature that it conforms very snugly to the surface which is to be cleaned. It can be forced through the tube with very little effort and each plate removes the particles of sedi-

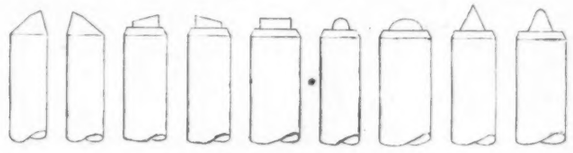
TUBE CLEANER.

ment or scale within the pipe. Another advantage of this cleaner is that it can be adjusted to fit various sizes of pipe, and if one or more of its blades become broken by rough usage or wear they can be readily repaired at nominal expense. This cleaner is manufactured by the H. W. Johns-Manville Company, 100 William Street, New York.

Black Diamond Pointed Tools.

For machining hard rubber, fiber, brass, phosphor bronze, copper, mica or other material of a tough, hard or gritty nature in which a tool of high-speed or other steel will not hold its edge, tools pointed with black diamonds have proved their worth. A thorough knowledge of the black diamond as to grain, hardness and density is positively essential to the successful manufacture of these specially shaped points and this is only obtained after years of experience and work on black diamonds for different mechanical purposes. Borts, a species of white diamond, an account of its lower cost is sometimes used for a few of the above purposes; its cleavage formation, however, renders it very liable to fracture and breakage especially on hard rubber and fiber. It is, therefore, very unsatisfactory in operation.

The black diamonds are ground to special shapes adapting them to different classes of work, as shown herewith, and are then given sharp cutting edges which are maintained for a



BLACK DIAMOND POINTED TOOLS.

very great length of time, when they may be resharpened. Tools of this nature have been in constant operation on hard rubber, fibre, brass and bronze compositions from 6 to 18 months before becoming dull and have also been in operation on turret lathes as finishing tools for brass pieces for 14 months without resharpening. The initial cost of the tool is high compared with other tools, but this is more than offset by their great durability which renders them invaluable where exact size must be maintained for many thousands of operations, as in exact duplication of parts. The black diamond pointed tool is operated at high speed with a light feed and cut, and in operation leaves a smooth, true and finished surface. The diamonds can be fitted to any holder. Thomas L. Dickinson, 45 Vesey Street, New York, is the manufacturer of these tools.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The reaction after the extraordinary holiday activity this year was less pronounced than usual at such times, and the commercial and industrial interests of the country look forward with confidence to the developments of 1907. Wholesale business is good for the season and collections show further improvement. Jobbers are delivering spring goods in some lines, adding to the freight congestion, which has not been relieved except in isolated cases. Manufacturers complain of the light receipts of fuel and raw material, which has reduced activity in many plants, and there is also some interruption because of inventories and repairs. On the whole, however, there is less idle machinery than is customary at this time. Lack of snow greatly facilitated building operations at many cities, and work is making rapid progress, although delayed deliveries of materials retard operations in this industry also. Car shortages still prevail, though the situation is somewhat better in such sections as the Northwest and parts of the South. Railway gross earnings for the first half of December exceed those of the corresponding time in 1905 by 8.5 per cent. The pig iron markets are active, and buying of this metal for delivery in the second half of 1907 is increasing in volume. A significant feature is the fact that buyers appear disposed to accept the present high level of prices, the feeling in this respect being in sharp contrast to that displayed early in the summer, when there was a tendency to question the permanency of high quotations. The demand for steel rails is still maintained. New business in structural material is not so large as it has been recently, but specifications are heavier. Plate mills are crowded with orders which will keep them busy for three months to come. Advances in sheets and tin plates, deliveries of which are backward, are looked for, and the demand for wire products as well as iron and steel bars is active. Copper is higher and spot supplies bring from 23½ to 25c. per pound. Neither the larger domestic nor the foreign copper producers will sell under present conditions for shipments beyond May. The business that has been effected for later deliveries is insignificant. One important domestic producing interest has withdrawn from the export market and is taking domestic business only from corporations in which the mine owners are in a community of interest. The president of these mining interests states that at the rate of growth of domestic consumption that has been maintained for two years, carried through 1908, the home markets will thereafter require all the copper that can be refined from the output of domestic, Mexican and Canadian mines controlled by American capital. This producer estimates the output of copper for 1906 from all properties controlled by American money in the United States, Mexico and Canada at 530,000 tons, which is fully five-sevenths of the estimated output of the world for this year. Producers' prices are: Electrolytic, March, April and May, 23¾ to 24½c.; Lake for prompt or future shipments is hard to get. Prices are merely nominal. Several important producers quote 24 to 25c. and then tell inquirers that they have none for shipment earlier than April. Prime brands of casting stock are at 24 to 24½c., sixty days. There were 161 business failures during the week ending December 27, according to *Bradstreet's*, against 227 in the preceding week and 212 in the corresponding week of 1905.

RECENT ALLIS-CHALMERS ORDERS.—The Allis-Chalmers Company makes note of the following orders: Jones & Naumburg, of New York City, who recently replaced the shafting and belting in their factory, at 516 West Twenty-fifth Street, by individual motor-drive, have purchased a new electric generating unit consisting of "Reliance" engine direct-connected to a 200 kw generator at 240 volts. The Lloyd Manufacturing Company, of Minneapolis, manufacturers of children's vehicles and steel and wire specialties, have ordered twenty-three induction motors, ranging in size from 2 to 15 hp, which are to be installed for operating the machinery in their plant. Power will be furnished by an alternating current generating set previously purchased. The motors are to run at speeds ranging from 1,200 to 1,800 r.p.m. Motor-driven rock crushing equipments are now becoming quite common. Among recent users of this class of apparatus is The Art Floor and Marble Company, of Toledo, Ohio, which has bought one of the style "F" breakers to be driven by a direct-current motor operating at 1,800 r.p.m. on current supplied at 120 volts. The Douglas Improvement Company, of Douglas, Ariz., has contracted for the delivery of nine induction motors to operate on two-phase current at 60 cycles, 2,200 volts, together with 30 small static transformers. The induction motors range in size from 2 to 10 hp and will be used for various industrial purposes. The German-American Button Company, manufacturers of a fine grade of tailor's buttons, has ordered for its new factory at Rochester, N. Y., twenty-seven induction motors. These motors were purchased through the Rochester Railway & Light Company, which will furnish the current on which they are to be run. The Lunkenheimer Company, of Cincinnati, has purchased for its works there seven 60-cycle induction motors, ranging in size from 7½ to 15 hp to be used in driving machinery for the manufacture of valves and other high-grade engineering specialties. The Portsmouth Stove & Range Company, of Portsmouth, O., has arranged to install machinery for lighting its plant and also supplying power to machine tools of various kinds. The equipment will consist of an alternating current generator belted to a high-speed engine and induction motors ranging in size from 2 to 15 hp. The city of Columbus, Ga., has lately acquired an addition to its industries in the shape of the Swift Spinning Mills, whose new yarn mill will include 10,000 spindles when in full operation. Contracts have already been placed by the new company for induction motors, transformers, etc., suitable for an electrically driven mill of most modern design. The electrical equipment will be furnished by the Allis-Chalmers Company, of Milwaukee; it consists of units ranging from 30 to 100-hp capacity, in induction motors and will include a number of oil-filled self-cooled transformers.

PNEUMATIC TOOLS.—Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, has just returned from his twenty-first trip to England and the Continent in the interest of the pneumatic tool business, having just spent six weeks abroad, at which time he visited the trade in general in England, Scotland, France, Germany, Belgium and Italy. Mr. Duntley reports the pneumatic tool business on the increase at all points abroad, and he is much gratified over the fact that the current year has shown an increase of between 25 per cent and 30 per cent over any previous year. The popularity of the product is attested through the fact that practically all foreign railways have installed these tools in their shops, as well as a great many of the larger industrial institutions and government ship yards. The Chicago company controls the market abroad about on the same percentage as throughout the United States, Canada and Mexico; that is, 90 per cent of the pneumatic tools used are of the Chicago Company's make.

ORDER FOR RAIL BONDS.—Another large order for Shawmut soldered rail bonds has recently been placed with the Chase-Shawmut Company, of Newburyport, Mass., by the Northern Electric Company, of Chico, Cal. This order is for 138,855 bonds, and was placed in connection with two other orders; one for 33,500 bonds and the other for 61,000, making a total of 243,355 bonds. The bonds used are 400,000 circ. mil. for the third rail, and 200,000 circ. mil. for the track. The Chase-Shawmut Company is also superintending the installation of these bonds.

RENEWED LAMPS.—The Bay State Lamp Company, Danvers, Mass., has given notice that the price of Bay State renewed lamps will be advanced one cent on January 1, the change being made necessary by the increased cost of all material entering into the construction of the lamps. The increase is partly offset by an additional allowance of one-half cent each for burned-out lamps.

DEVELOPMENT IN MEXICO.—An enormous amount of American capital has been invested in electrical enterprises in Mexico during the last year. While a group of Canadian capitalists take the lead in this character of investment in the matter of the size of the enterprises which they are establishing. American investors have outstripped all others. Many of the best paying mines of Mexico are owned by Americans, and it is in these that electrical installations have been made. Americans are also taking the lead in the development of the water powers of Mexico. In the mountainous regions of this country there are many waterfalls which afford ideal locations for hydro-electric plants. The electrical supply houses in Mexico City, Monterey and other towns of the republic all report an unusually large business during the last year. The Pinguico Mines Company, of Guanajuato, will install fifty additional motors in its mines and mill. The mines of this company were equipped some time ago with electric hoists and electric pumps. This company as well as all of the other leading mining companies operating in the Guanajuato district obtain electric power from the Guanajuato Electric Light & Power Company. The transmission lines of this company run to the Guanajuato district from El Duro where its hydro-electric plant is located. In addition to furnishing the numerous mines with electric power the company also furnishes power for operating electric tram lines for handling the ore between the various mines and mills. The introduction of electricity into the Guanajuato district has cheapened to a marked degree the cost of mining operations and has greatly increased the ore output. The Negociation Minera de Maravillas y Anexas which operates large mines in the Pachuca district has just installed a large electric double drum hoist. It will handle a loaded cage of 4,500 pounds at 700-feet rope speed per minute. The hoist is arranged for handling the load, either in balance or out of balance, and is handled by a 225-hp hoisting motor, the energy of which is supplied by a 2,000-volt, 50-cycle circuit. Compania Industrial de Guadalajara is preparing to build a transmission line from its power plant at Las Juntas to the Etzarlan mining district, State of Jalisco. It is estimated that the line will cost about $200,000. It is stated that more than 3,000-hp can be contracted for in the Etzatan district as soon as the line is built and that this amount will be increased rapidly. Additional machinery will be installed in the Las Juntas plant. Electric plants for pumping water for irrigation purposes are being installed in different parts of Mexico. A large number of electric pumps are being installed near Ocatlan, State of Jalisco, by the Lake Chapala Agriculture & Improvement Company. The water is raised from Lake Chapala to a height of thirty to fifty feet and used to irrigate a large tract of land. Some of the pumps are already in operation. An electric irrigation plant is also being installed on the Castillo Hacienda in the State of Jalisco. The water will be pumped from the Santiago River and used to irrigate a large tract of land which has heretofore been uncultivated. Compania Agricola y Fuerza Electrica of Santa Rosalia, State of Chihuahua, will soon let the contract for the installation of a hydro-electric plant on the Conchos River near Santa Rosalia. The water power is expected to develop about 3,500 hp. This power will be transmitted by transmission lines to the cities of Chihuahua, Parral, Jiminez and Santa Rosalia. Paul C. Ginther, of Santa Rosalia, is largely interested in the proposed enterprise. Max H. Lange, an American engineer of Mexico City, will install a large hydro-electric plant on the Azul River in the State of Guerrero. The plant will be located near the town of Colotipa. Transmission lines will be built to the city of Chilpancingo and other towns and industrial centers in the State.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, manufacturer of automatic telephone systems, has enjoyed the busiest and most prosperous year of its existence. At present there are nearly $7,000,000 worth of orders on hand to be filled. These include some large plants, Denver, Omaha, San Francisco and Chicago being among the number. So enormous has been the growth of the business that the factory has been more than doubled in size and trebled in capacity. The new addition will be available shortly after New Year's, and the enlargement will enable the company to cope with the constantly increasing demands for automatic equipment. During the past year the Automatic Electric Company issued and sold the last $1,000,000 of its $5,000,000 capital stock, to provide additional working capital for its increased business. Perhaps the most important contract which the company will handle this coming year will be for the 100,000 line exchange to be built in Chicago by the Independent Telephone Company of Chicago, a $10,000,000 corporation, which has been formed by some of the leading financiers in the independent movement. This company has taken over the telephone rights of the Illinois Tunnel Company, the growth of whose automatic plant, serving the loop district only, has been retarded by reason of the fact that the latter company has devoted its entire capital and energy to the completion and perfection of its tunnel system for freight and mail service. The new independent telephone company for Chicago is, it is said, an assured fact. In line with the new independent company's advent into Chicago are the arrangements for the entrance of the independent toll lines. The South Bend Home Telephone Company, of South Bend, Ind., has been purchased by a company of independents who will make that city the clearing point for the independent toll line business of that half of the United States lying east of that meridian of longitude. Similar arrangements will be made for the western and northern territory. The greatest development of the automatic business the past year has been on the Pacific Coast. Contracts have been made during the past year for automatic plants at San Francisco and Oakland in California (as well as large additions to the Los Angeles automatic system) at Portland, Ore., and at Spokane, Tacoma, Bellingham and Walla Walla, Wash.

TELEPHONES IN FRANCE.—U. S. Consul-General Robert P. Skinner, of Marseille, thinks that there ought to be a good market in France for small telephones for intermural use, but there are difficulties in the way of selling them for use in connection with the public exchanges. General telephonic communication is a Government monopoly in France. In the large cities, like Marseille, one does not rent an instrument at so much per year, without further responsibility therefor, as in America. One begins by making application for connection and service. For this a fixed rental is paid, after which one pays the State for the wire used in making the connection, and finally purchases the instrument itself. But the instrument cannot be adapted to the public service unless it is of a type approved by the State and bears the Government stamp. Consequently, manufacturers who desire to engage in this business must submit their types to the Director de l'Exploitation Téléphonique et Télégraphique, at Paris, for inspection, and if they are found acceptable, each instrument must be marked. Nor is this all, for the mark is good for one year only. If the instrument be not sold before the expiration of one year, the dealer must send it back to Paris to be remarked, and run the risk of its rejection, this risk, however, being remote. It follows that retail dealers keep only one or two types of instruments on hand, and practically every sale means a special order upon the manufacturer. Foreign manufacturers could hardly hope to build up a very large trade without a first-class general agency in Paris, to push the business and take charge of official matters.

ISOLATED COUNTRY PLANTS.—Mr. Putnam A. Bates, 42 Broadway, New York, whose article on isolated plants for country homes appeared in these pages last week, and whose article on the electric grill appears in our current issue, is very actively engaged at the present time in such work as those topics imply. During the past year he has designed and equipped no fewer than twenty installations for out-of-town clients, who have adopted electricity for reasons of economy and convenience as a source of light and power on their country estates. Many of these installations have included complete electric generating and storage plants, motor drives for farming and domestic utility purposes, and electric distribution systems for lighting, heating, power and telephone service. Among the most interesting equipments which Mr. Bates has put in are those at the residences of Mrs. H. M. Curry, Magnolia Beach, Mass; Mr. Wm. Bayard Blackwell, Morristown, N. J.; Mr. Robert D. Foote, Morristown, N. J., and Mr. Julien T. Davies, Great River, L. I. Some of Mr. Bates' other recent work has been the equipment of the new Library Building, Tufts University; the new Carnegie dormitory, Lehigh University; Florida State Normal and Industrial School; First National Bank of Morristown; United States Rubber Company, Quintard Iron Works Company, Atlantic Coast Lumber Company, the H. F. Taintor Manufacturing Company, and the General Rubber Goods Company.

LIGHTING AT BAYONNE, N. J.—The following contract, made at Bayonne by the Public Service Corporation of New

Jersey, is of interest: "The company agrees to provide and maintain as many arc lamps for lighting the streets in the city of Bayonne as the party of the first part may from time to time order for the term of 5 years from the first day of October, 1906, at a cost of $85 per year for each said arc lamp until the first day of January, 1908; providing that at no time during said term shall the number of said arc lamps be less than 250; after the said first day of January, 1908, at a cost of $80 per year for each arc lamp; providing that at no time during the balance of the term of this contract shall the number of said lamps be less than 350; said lamps to be lighted each and every night from sunset to sunrise during the term of this contract. That each lamp at all times shall give a light equal to the standard lamp of 9 6/10 amperes at 45 volts, being what is known as a 2,000-candle power lamp. The company also agrees to furnish electric power sufficient to operate the fire and police telegraph alarm system in the police station of the city, and that the price of electric incandescent lighting to the city for public buildings, including fire engine houses, police stations, school houses and free public libraries, shall, during the term of this contract and any renewal thereof, be the sum of 8 cents per kilowatt-hour."

MUNICIPAL PLANT AT BROOKHAVEN, MISS.—The town of Brookhaven, Miss., has recently awarded contracts for a new municipal lighting plant consisting of one 200-kw and 100-kw alternating current generators to furnish lighting and power for the street lamps, etc. The contract for the generator was secured by the Crocker-Wheeler Company, of Ampere, N. J. The ratings of these machines which are to be furnished are as follows: One 200-kw engine type alternating current generator, three-phase, 60-cycle, 2,300 volts, 200 r.p.m., and one 100-kw belt type alternating current generator, three-phase, 60-cycle, 2,300 volts, 700 r.p.m. A 13-kw generator is to be furnished as exciter for the belt type generator. This will give the plant a capacity of 300-kw alternating current.

ALUMINUM COMPANY OF AMERICA.—By action of the stockholders and directors of and on approval thereof by the proper officers of the commonwealth of Pennsylvania, the name of the Pittsburgh Reduction Company has been changed to Aluminum Company of America, the new name to go into effect January 1, 1907. It was desired to conduct the business of the company under a name which discloses the nature of the business. The change is solely one of name, as the stockholders, directors, policy, management, officials, etc., remain as heretofore. The growth of the field for aluminum is shown by the fact that the consumption in 1905 was 11,347,000 pounds valued at $3,246,300, as compared with 8,600,000 pounds valued at $2,477,000 in 1904.

MUNICIPAL PLANT FOR ORANGE, N. J.—The city of Orange has recently awarded contracts for the erection of a new municipal lighting plant, which is to furnish lighting and power for the street lamps and police buildings. The contract for the electrical machinery was awarded the Crocker-Wheeler Company, of Ampere, N. J. The equipment will consist of three 150-kw alternating current generators, 2,300 volts, 200 r.p.m. This plant is situated within a few miles of the Crocker-Wheeler Company's main office and works, at Ampere, N. J. The Orange officials visited the plant and inspected the detailed construction of its generators before awarding the contract. The inspection was evidently very satisfactory.

EQUIPMENT OF A TUBE MILL.—The Seamless Tube Company of America, which is affiliated with the Pittsburg Steel Company, and whose works are situated at Monessen, Pa., has recently purchased four 300-hp Allis-Chalmers compound-wound, non-reversible direct-current motors. Speed variation will be obtained by means of shunt field regulation and each motor will be furnished with a starting panel, including an automatic circuit breaker and switch. One motor will be connected by gears to a 20-inch two-high mill for rolling tubes. One will be direct-connected to a mill for piercing steel billets, and two will be connected by gearing to cold draw benches for cold drawing tubes.

JUNK.—The *Sioux City Journal* (Ia.) is responsible for the subjoined item: "All the lead cable on the poles of the Iowa Telephone Company in the business section of Sioux City, amounting to 60,000 feet, has been sold for about $50,000 to Frank Gottstein, of the Iowa Iron & Metal Company, a Des Moines junk dealer. The cable which Mr. Gottstein purchased in one of the largest junk deals ever made in Iowa is still strung overhead on the poles of the company in Sioux City. It is no longer in use, however, having been replaced by underground cables, in accordance with the city ordinance requiring wires in the business district to be put underground."

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull but exhibited a rather steady undertone. Liquidation in high-priced inflated railway shares has ended and conditions are more nearly normal than for some weeks past. A feature was the relative firmness of low-priced dividend payers and specialties. In the face of current money market conditions there was little public demand for stocks. The one feature of the curb market for outside securities was a general disposition to take profits in mining shares, resulting in recessions in nearly all of them. Little business was transacted in electrics and tractions and these securities are all lower, with the exception of General Electric, which closed the week with a net gain of 2 points. General Electric rights were dealt in to the extent of 3,800 shares at prices varying between 12 and 11⅛, the former being the closing quotation. Twin City Rapid Transit dropped from 106 to 103. The following table shows the highest and lowest prices for the year for the principal electric securities:

	High.	Low.
American Telegraph and Cable	93¼	86
American Telephone & Telegraph	144⅝	130
Central & S. Am. Tel	140	137
Electric Storage Battery	87½	81¾
Metropolitan Street Ry	123	103
New Orleans Ry. & Light	36⅞	32⅞
New Orleans Ry. & Light, pfd	83	80¼
N. Y. & N. J. Telephone	155¼	125
Westinghouse, com.	176	148
Westinghouse, 1st pfd	188	162
Allis-Chalmers, com.	27⅜	16
Allis-Chalmers, pfd.	67	40
American Locomotive, com.	78½	53¾
American Locomotive, pfd.	120¼	108½
Brooklyn Rapid Transit	94⅞	71
General Electric	184	156
Interborough Metropolitan	55⅜	33⅝
Interborough Metropolitan, pfd.	87⅜	70⅜
United States Steel	50¼	32⅝
United States Steel, pfd.	113½	98¾
Western Union	94¼	83¾

Following are the closing quotations of December 31:

NEW YORK

	Dec. 24	Dec. 31		Dec. 24	Dec. 31
Allis-Chalmers Co.	16⅛	16⅞	General Electric	156¾	160
Allis-Chalmers Co. pfd.	43⅜	45	Hudson River Tel	...	...
American Dist. Tel	...	...	Interborough Met. Com.	...	35¼
American Locomotive	71¼	...	Interborough Met. pfd.	...	73½
American Locomotive pfd.	119¼	...	Mackay Cos.	70¼	69⅝
American Tel. & Cable	88	85	Mackay Cos. pfd.	67⅛	66⅛
American Tel & Tel.	...	...	Marconi Tel	...	...
Brooklyn Rapid Transit	78⅛	78¾	Metropolitan St. Ry.	...	...
Electric Boat	31	30	N. Y. & N. J. Tel.	...	...
Electric Boat pfd	74	73	Western Union Tel.	*83⅜	83⅛
Electric Vehicle	...	...	Westinghouse com.	149	152
Electric Vehicle pfd	...	...	Westinghouse pfd.	...	...

BOSTON

	Dec. 24	Dec. 31		Dec. 24	Dec. 31
American Tel & Tel.	135	134¾	Mass. Elec. Ry. pfd	68	67
Cumberland Telephone	...	...	Mexican Telephone	...	...
Edison Elec. Illum.	230	...	New England Telephone	...	126
General Electric	...	...	Western Tel. & Tel.	...	9
Mass. Elec. Ry.	18⅛	18	Western Tel. & Tel. pfd.	50	..

PHILADELPHIA

	Dec. 24	Dec. 31		Dec. 24	Dec. 31
American Railways	50⅛	50⅛	Phila. Electric	7¾	8
Elec. Co. of America	11	10⅞	Phila. Rapid Trans	22⅝	20¼
Elec. Storage Battery	65	65	Phila. Traction	...	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Dec. 24	Dec. 31		Dec. 24	Dec. 31
Chicago City Ry.	160	...	National Carbon	85	85
Chicago Edison	...	...	National Carbon pfd.	116	115
Chicago Subway	...	...	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	26⅛	26			

*Ex-dividend

NEW YORK LIGHTING BIDS.—Bids for New York City electric street lighting for 1907 have been opened by Commissioner O'Brien. In Manhattan the city will have to pay $100 a year each for 5,000 arc lamps, and for the 200 additional lamps $95 each. The price in Brooklyn remains at $100, Richmond $90, Bronx $100, and in the better part of Queens $80.12. For the double electric lamps along Fifth Avenue the price is $130 a year. Incandescent street lamps in Manhattan will cost $22.50 a year, as previously, and the other boroughs, except Brooklyn, for which no bid was received, will have to pay $25.

PUBLIC UTILITY EARNINGS.—According to the well-informed *Wall Street Journal*, January dividend and interest disbursements in New York will amount to more than $180,000,000. This is an amount considerably larger than was ever before disbursed in one month and exceeds that paid out in January, 1906, by several million dollars. Up to the present time 186 industrials, public service corporations and railroads and seventy New York City banks and trust companies have declared dividends for January payment amounting to $71,345,973. The interest due in January on outstanding bonds of 559 industrials, railroads and public service corporations amounts to $94,768,118. The amount of interest due on Government bonds during the coming month is $10,858,199, making a total of $105,626,317 due for interest. The aggregate total of these dividends and interest disbursements will amount to $176,972,290. The dividend disbursements to be made may be summarized as follows: 96 industrials and miscellaneous companies, $26,024,642; 47 public service corporations, $11,912,992; 43 railroads, $26,877,139; 70 New York City banks and trust companies, $6,531,200. Total, 256 companies, $71,345,973. The interest disbursements to be made may be summarized as follows: 312 railroads, $70,558,195; 202 public service corporations, $17,912,179; 45 industrials and miscellaneous companies, $6,297,744. Total, 559 companies, $94,768,118; Government bond interest, $10,858,199. Total interest disbursements, $105,626,317. The largest amount to be disbursed in dividends during the month by any one corporation is $3,173,236, which will be paid by the American Telephone & Telegraph Company. The next largest amount is $2,967,990, which is to be paid by the Lake Shore & Michigan Southern. The New York Central is to pay $2,241,638, making $5,209,628 to be paid by the two Vanderbilt companies. The General Electric Company disburses $1,086,124. The Niles-Bement-Pond Company is to disburse $2,000,000, but this, in part, is in the nature of a stock dividend. The Westinghouse Air Brake gives out $557,500 in dividends; the Westinghouse Machine Company $125,000; the Westinghouse Electric preferred, $99,967; common, $459,250; Mackay Companies, $820,260; Western Union Telegraph, $1,217,125.

DIVIDENDS.—The directors of the Standard Underground Cable Company have declared a regular quarterly dividend of 3 per cent, and an extra dividend of 5 per cent, payable January 5. The directors of the Philadelphia Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable February 1. The Dayton City Railway Company has declared a special dividend of 5 per cent, payable February 1. The directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1½ per cent and 1 per cent extra, payable January 15. In announcing the quarterly dividend, the directors of the New York & New Jersey Telephone Company state that hereafter the regular quarterly dividend shall be at the rate of 1¾ per cent, so as to distribute the annual dividend of 7 per cent uniformly throughout the year. The directors of the Manchester (N. H.) Traction, Light & Power Company have declared a regular quarterly dividend of $1.50 and $1 extra, payable January 15. The Hall Signal Company has declared a quarterly dividend of ¼ of 1 per cent on the preferred stock and a quarterly dividend of 1¾ per cent on the common stock, both payable January 2. The International Nickel Company has declared a quarterly dividend of 1½ per cent on the preferred stock, payable February 1. The Washington Water Power Company, of Spokane, has declared a quarterly dividend of 1¾ per cent, payable January 2. E. W. Bliss & Co. have declared a quarterly dividend of 2½ per cent on the common stock and 2 per cent on the preferred stock, both payable January 1.

NEW YORK-PORTCHESTER TROLLEY.—The issue by the New York & Portchester Railroad Company of a mortgage for $20,000,000 and an increase of its capital stock from $250,000 to $20,000,000, has been approved by the State Railroad Commission. A statement issued says: "It appears that substantially all of the capital stock of the New York, Westchester & Boston Railway Company, whose proposed line is substantially the same as the New York & Portchester Railroad Company, is owned by the owners of the stock in the latter-named road. It is provided that at no time shall the aggregate amount of mortgage bonds outstanding in both railroads exceed $20,000,000, and at no time shall the aggregate amount of outstanding capital stock of both companies exceed $20,000,000 at par value."

CUYAHOGA TELEPHONE EARNINGS.—The report of the Cuyahoga Telephone Company for November was probably the most favorable that has been issued for some years. Gross receipts as compared with the same month a year ago show an increase of $9,172.07, while the expenses increased only $1,092.69, leaving a gain in net earnings of $8,079.38. Notwithstanding the fact that there has been an increase in the deductions, due to larger fixed charges and preferred dividends, the surplus for common stock is still $5,766.88. The co-operative plan, through which a distribution has heretofore been made to employes, was done away with, and the sums thus paid out now go to the amount to be distributed among the stockholders. The comparative report is as follows:

	Nov., 1905.	Nov., 1906.
Gross earnings	$53,378.26	$62,550.32
Expenses, taxes, etc.	30,853.09	31,945.75
Net earnings	22,525.16	30,604.54
Interest on bonds	11,250.00	11,250.00
Dividend on preferred stcok	16,118.00	18,430.50
Surplus for common stock	4,868.00	7,180.50
Total	6,497.16	12,174.04

GENERAL ELECTRIC EARNINGS.—The statement of the General Electric Company for the nine months ended October 31, 1906, shows that the surplus is given as $16,710,134, a gain of $4,682,839, as compared with the total reported on January 31, 1906, the close of the company's fiscal year. It appears from the company's statement that it has earned during the nine months something like $7,941,056, a gain of $621,895 over the earnings in the complete fiscal year ended January 31, 1906. In other words, the company has earned more in the nine months than in the entire fiscal year of 1906. The apparent earnings for the nine months in question were equivalent to 14.6 per cent on the $54,306,200 capital stock, or at the rate of 19.47 per cent a year. The amount billed out for the nine months was $41,774,812, which would give about $55,000,000 for the whole year as compared with $44,419,613 in 1905.

NEW TELEPHONE STOCK.—The directors of New York & New Jersey Telephone Company have voted to offer stockholders $6,310,166 of stock at par in the proportion of one share for every three shares held, to stock of record December 31. The right to subscribe will expire January 31. The offer which has just been made to the stockholders is a portion of the $35,000,000 increase in the capital stock which was authorized October 25, 1905. Of this new stock, $3,442,525 was previously offered to stockholders at par, payable in four installments, the last payment to be made October 1, 1906, and $1,721,100 at par, payable August 1, 1906. With the latest offer included this company will have issued $11,473,831 of the $35,000,000 authorized, leaving a balance not as yet issued of $23,526,169. Application will be made to the New York Stock Exchange to list the stock of the company.

CLEVELAND-BUFFALO TROLLEY.—Governor Pennypacker, of Pennsylvania, has approved the merger of the Buffalo & Lake Erie Traction Company with the Erie Rapid Transit Company, under the name of the former corporation. The capital is to be $6,750,000, of which $4,420,000 was of the Buffalo & Lake Erie. Joseph D. Moyer, of New York, is the president of the concern. It is understood that the company is to form one of the links in the chain of trolleys between Buffalo and Cleveland. New York and Philadelphia capitalists are the incorporators of the merged company.

OHIO COMBINATION.—It is rumored that an option on all the properties of the Shenango & Mahoning Railway & Light Company has been secured by Eastern capitalists. The properties embrace the street car lines of the New Castle, Sharon, Youngstown and connecting interurban lines, and the electric light plants with Cascade Park. Ex-Governor Myron T. Herrick, of Ohio, and James Parmalee, of Cleveland, O., are dominant factors in the deal.

KANSAS CITY EARNINGS.—The report of the Kansas City Railway & Light Company for November shows a gross of $466,220 and a net, after taxes and interest, of $90,303. For the six months the gross is $2,872,989 and the net, $588,646, an increase over 1905 of $76,262.

DAYTON TROLLEY STOCK.—The City Railway Company, of Dayton, O., has increased its common capital $100,000 and offers the stock to present stockholders at par pro rata at the rate of one share for every twenty held.

THE NORTHERN WESTCHESTER SECURITIES COMPANY has been incorporated in Connecticut under the direction of the law firm of Messrs. Parker, Hatch & Sheehan, of New York City, who are in charge of all legal questions involved in the company's affairs. It is formed mainly for the purpose of acquiring from time to time the securities of public service corporations and other companies, particularly the traction, gas and electric light, heat and power companies operating in the northern part of Westchester County, and also for the purpose of advancing to such companies money necessary for alterations, extensions and improvements to provide for increased business. It has already acquired common stock of the Peekskill Lighting & Railroad Company, which is pledged with the Knickerbocker Trust Company as security for the payment of the thirty-year collateral trust 5 per cent gold bonds issued by the Northern Westchester Securities Company. The principal amount of said bonds issued at this time is $120,000. The policy of the Northern Westchester Securities Company is to issue, from time to time, bonds and stock to pay for the entire common stock of the Peekskill Lighting & Railroad Company, which it has under contract, and to purchase by issue and sale of bonds and stock from time to time the preferred stock of the Peekskill Lighting & Railroad Company when and as it can be secured at a satisfactory price; and, further, it proposes to purchase the stock of the Northern Westchester Lighting Company at such time and at such rates as will justify further issues of its bonds and stock to pay for the same. It may also purchase bonds of the Northern Westchester Lighting Company and possibly of the Peekskill Lighting & Railroad Company. The Securities Company also contemplates financing the Hudson River & Eastern Traction Company, furnishing money with which to build its lines, and taking therefor its bonds and stock, on some satisfactory and proper basis to be agreed upon. Dividends on all the common stock of the Peekskill Lighting & Railroad Company go to the Northern Westchester Securities Company, and the prospect now is that the stock of the Northern Westchester Securities Company will pay a small quarterly dividend in April next. The Peekskill Company for the year ending October 31, 1906, earned gross, $142,995, and net, after interest on bonds, $39,070.

CONNECTICUT TROLLEYS.—The New York, New Haven & Hartford Railroad Company offers to exchange one share of its capital stock for each $200 face value of the 50-year 4 per cent debentures of the Consolidated Railway Company, issued from July, 1904, to January, 1906, between October 20, 1906, and June 30, 1907. Holders of debentures will be credited with accrued interest on their debentures at the date of exchange, and debited with accrued dividends on stock received in exchange. Receipts will be given for debentures delivered and stock certificates will be issued as soon as practicable upon the surrender of these receipts. The trolley system of the Rhode Island Company has passed formally to the control of the New York, New Haven & Hartford Railroad Company. The company's lines, comprising seventy-one miles, are located in Rhode Island, Southern Massachusetts and Eastern Connecticut.

CLEVELAND TROLLEYS.—Major Johnson, of Cleveland, having entered into an agreement with E. W. Scripps, of the Scripps-McRae Press Association to finance the Forest City Electric Railway, popularly known as the "Three Fer," by guaranteeing the stock and exploiting the merits of the company before the public through the columns of the Cleveland press, has been accused of being financially interested in his favorite "Three Fer" Company, and implicating himself in this regard by public statements. In view of this, Judge Phillips, of the United States Supreme Court, has declared unofficially that the franchises granted the Forest City Company are void. A new corporation, known as the Low Fare Railway Company, was promptly formed for taking over the franchises of the Forest City Company. It has already taken over the rights of the Municipal Company, which is the lessee of the Forest City.

PLANT FOR JOLIET, ILL.—Advices from Joliet, Ill., state that prominent men in the Chicago Edison Company are included in the new combination of the Economy Light & Power interests and those of the Logan-Munroe syndicate. The Economy's charter and name are retained. Frank G. Logan and Charles A. Munroe have been added to the directorate and the capitol stock has been increased to $3,500,000 with an equal amount of bonds. There will be spent at once $2,000,000 on a dam and power house at the head of Lake Joliet and one near the head of the Illinois River. The company will own all the water power rights between Chicago and the Illinois River. No opposition to the development plans is expected. These interests represent ownership of all water power rights along the line of the drainage channel and the Des Plaines River, except the sanitary district of Chicago.

BELL TELEPHONE OUTPUT.—Subjoined is the output of instruments by the American Telephone & Telegraph Company for the month ending November 30 and since January 1:

	1906.	1905.	1904.
Gross output	151,208	183,470	103,922
Returned	57,711	49,075	39,934
Net output	93,497	134,395	63,988
Jan. 1 to Nov. 30:			
Gross ouput	2,005,611	1,677,800	1,094,291
Returned	687,810	566,553	465,631
Net output	1,317,801	1,111,247	628,660
Total outstanding	7,016,059	5,591,811	4,408,177

This should mean 3,500,000 sets of apparatus and over 3,000,000 subscribers connected or under contract.

BOSTON EDISON GROWTH.—Edison Electric & Illuminating Company stockholders have authorized the issue of 24,200 shares of new stock, which probably will be issued at about $200 per share, netting about $4,800,000. The company is planning to increase the capacity of its plant by the addition of two new turbo-generator sets, which will necessitate the enlargement of the power house. In its L Street station, South Boston, the company recently installed a turbo-generator set, and has placed an order for another, which, it is expected, will be ready by August next.

SOUTHERN PACIFIC TROLLEYS.—In its annual report just made by the Southern Pacific Railroad Company, the table of stocks and bonds owned shows that the Southern Pacific holdings of Pacific Electric Railway Company stock have been brought up to $10,000,000, or half of the issued stock. Thus, on the Pacific coast, as well as on the Atlantic, the relations between the trunk-steam systems and the paralleling trolleys are becoming closer.

SALE OF MAINE TROLLEYS.—President Lynch, of the Augusta, Winthrop & Gardiner Electric Railway Company, states that an agreement has been reached for the sale of that road to John R. Graham, of Bangor, representing a syndicate of Philadelphia and New York capitalists, who already own or control the Lewiston, Brunswick & Bath Electric Railroad and the Bangor street railway system.

AMERICAN GAS & ELECTRIC.—At Albany, N. Y., on December 20, the American Gas & Electric Company, of New York City, was incorporated with a capital of $7,000,000 to manufacture apparatus and machinery for storage and disposing of gas, electricity, water and steam. The directors include H. L. Doherty and W. H. Pitkin, Jr., of New York City and M. C. Humstone, of Brooklyn.

STANDARD UNDERGROUND CABLE.—A special meeting of the stockholders of the Standard Underground Cable Company has been called in Pittsburg for January 22 to act on a proposed increase in the capital from $2,000,000 to $3,000,000. It is understood that part of the increase will be in the nature of a stock dividend.

BONDS FOR CARTERSVILLE.—Under a decision handed down by the Supreme Court of Georgia the city of Cartersville is given the right to issue bonds to the amount of $40,000 for the purpose of constructing and equipping an electric lighting plant and for enlarging the gas plant and water works.

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company reports for November a gross of $477,118, or $50,000 over the month in 1905. The eleven months gross was $5,073,368, a gain of about $800,000. The surplus for the eleven months is $1,669,740.

MEXICAN TELEGRAPHS.—The Mexican Telegraph Company has issued its quarterly statement for the period closing December 31. It shows $165,000 gross, an increase of $12,000 over 1905, and a surplus after dividends, etc., of $78,748.

POWER FOR COBALT.—It is proposed to form a company to furnish power for the Cobalt mines, Canada. The plan is to develop 40,000 hp on the Quinze River, 18 miles from Cobalt camp.

GENERAL NEWS.

Construction News.

BISBEE, ARIZ.—A franchise is reported to have been granted to the International Gas & Lighting Company.

YUMA, ARIZ.—George W. Norton, of Mohawk, Ariz., of the Engineering Mining Company, writes that the company is figuring on developing power for electrical purposes, but surveys are not yet complete. It is proposed to construct a transmission line about 35 miles in length.

SANTA ROSA, CAL.—The City Council has granted the Pacific Gas & Electric Company a franchise to transmit electricity through this city.

ROSEVILLE, CAL.—The Supervisors of Placer County at Auburn have granted E. D. N. Lehe a franchise for an electric light plant in Roseville.

LOS ANGELES, CAL.—An ordinance has been passed creating a conduit district and prohibiting the erection of poles and wires within said district.

SELMA, CAL.—The San Joaquin Power & Light Company is negotiating for the plant of the Selma Light & Water Company. A. G. Wishon is manager of the San Joaquin Power & Light Company.

LOS ANGELES, CAL.—The electric light plant of the Los Angeles Gas & Electric Company, at 6th and Palmetto Streets, has been damaged by fire. The switchboard in the transformers room and nine generators are stated to have been destroyed. James W. Warren is general superintendent.

UKIAH, CAL.—The Fort Bragg Electric Company has applied for a franchise to erect and maintain a wire line for the transmission of electricity for light, heat and power over certain highways in the county. Bids for the above franchise will be received by the Board of County Supervisors until February 4.

SAN BERNARDINO, CAL.—Henry L. Green, of Los Angeles, has filed a claim for 2,000 inches of water in Waterman Canyon, and states that it is the intention to erect a hydro-electric power plant at the mouth of the canyon on the north bank of the stream, and another plant three miles from the Waterman ranch.

MENDOCINO, CAL.—The Mendocino Electric Light & Power Company is purchasing material preparatory to rebuilding its line to Caspar and constructing a new line to Jughandle Bridge. The Fort Bragg company will build its line from Novo to connect with the line at Jughandle. The Mendocino company will probable extend its pole line south from Albion to Whitesboro, as the residents there are anxious for electric light. The company may extend its line to Greenwood in the spring. A. Brown is manager.

PACIFIC GROVE, CAL.—C. W. Allen and R. C. P. Smith have sold their interests in the Monterey & Pacific Grove Electric Railway and in the Monterey County Gas & Electric Company to George S. Heazleton, of San Francisco, and E. P. Bolles, president of the First National Bank, of Oakland. Extensions of the present Presidio line through Pacific Grove to Carmel-by-the-Sea, and from Del Monte to Vista del Rey, are projected, as is also a line to Salinas. W. H. P. Hill has been appointed manager.

EDISON, CAL.—The Edison Electric Company, of Los Angeles, Cal., has ordered for its hydro-electric plant on the Kern River, at Edison, Cal., eight Allis-Chalmers direct-current motors with controllers and gearing equipments, to be used for operating 28-inch gate valves. The motors will be 120-volt, series-wound machines of the vertical shaft type, fully enclosed, and especially adapted to the service required. This company has installed on the Kern River at Saliente five 3,200-kw, alternating-current generators direct-connected to hydraulic turbines, also of Allis-Chalmers make.

LONG BEACH, CAL.—The Board of Trustees has granted to the Pacific Electric Company a franchise to operate a steam railroad over Daisy Avenue and with the right to operate cars run by electricity. In consideration of the franchise the Pacific Electric Company has consented to the opening of the extension of Daisy Avenue across the private right of way of its Fourteenth Street line, subject to its rights to lay down its tracks and operate its line thereon. Engineers for the Pacific Electric Company have completed the survey for the new short line from Wilmington to Long Beach, and active operations will begin as soon as the reports are approved. The road begins at the Fourteenth Street line connecting with the San Pedro branch at Eighth Street in Wilmington, a distance of five miles.

COLORADO SPRINGS, COL.—At a special meeting of the Board of Trustees of the town of Manitou held Dec. 22, W. C. Donerrer and Wesley Compton, representing a Boston and New York syndicate, were granted a franchise for the construction of an electric railway through the streets of Manitou, and to be continued into Crystal Park on the southern slope of Pike's Peak. The road, with its equipment, will cost $250,000, and work is to be started this winter. The road will be built primarily as a scenic line for tourists and may be continued to Pike's Peak and the Cripple Creek district.

DENVER, COL.—Plans have been completed by the Colorado & Southern Railroad Company for the construction of a double track electric line between Argo and Fort Collins, touching Longmount, Loveland and other intermediate points, and has also made arrangements with the Denver City Tramway Company to run its electric trains into the business section of the city of Denver over the Tramway Company's tracks. The company plans to gridiron the country between Denver and Fort Collins with electric lines within two years at a cost of approximately $3,000,000. Much of the material and equipment have been contracted for.

WOODBURY, CONN.—McCarthy & Downs, of Boston, Mass., have secured the contract for the construction of the new Woodbury-Waterbury electric railway. The new line will pass the southerly end of Lake Massapaug and will be 12 miles long.

HARTFORD, CONN.—C. J. Danaher will make application to the next General Assembly for a charter for a corporation to be known as the Hartford, New Britain & Meriden Railway Company, with power to construct and operate an electric railway between the three cities named in the title.

NEW BRITAIN, CONN.—The Farmington Valley Telephone Company has given notice of its intention to ask the next General Assembly for the right to extend its business into any town in the State. The Farmington Valley Company's principal office is in New Britain, and is operating a telephone exchange business in the towns of New Britain, Farmington, Avon, Canton, Plainville, Granby, New Hartford and Winchester.

MONTVILLE, CONN.—Several leading men of the town have prepared a petition for presentation to the next session of the General Assembly for a charter for an electric railway to connect Montville with Palmertown and Uncasville. The company is to be known as the Oxoboro Valley Railway Company, and the parties interested in the enterprise are Alexander C. Robertson, Robert C. Surchard and John B. Lathrop.

WATERBURY, CONN.—Attorney Frank S. Bishop, Henry M. Osborn, bursar at Yale, and William J. Tracy, of Waterbury, have prepared a petition for the next session of the General Assembly, asking for a charter to build an electric road from Danbury to New Milford. The line will be 4 miles long and the estimated cost is $30,000 a mile. Attorney Bishop has stated that it is to be an independent enterprise and if the charter is obtained will be constructed at once, as the capital has been secured.

HARTFORD, CONN.—The Northern Connecticut Light & Power Company, which represents a consolidation of the gas and electric plants of Windsor Locks and Thompsonville, will apply to the incoming Legislature for important additional franchises. It seeks a charter to erect and maintain gas and electric power plants in Suffield, East Granby, Simsbury and Buckland and to manufacture and distribute electricity for light and power purposes in Windsor and Somers. The company will greatly extend the area of its operations if it secures the necessary franchises.

UNIONVILLE, CONN.—A petition will be presented to the next General Assembly for an amendment to the charter of the Union Electric Light & Power Company of this village to allow it to enter the towns of Avon, Canton and Burlington. The company has a plant in active operation and has been furnishing electricity for several years in the streets of Unionville and the borough of Farmington is lighted from this plant. The plant consists of three dynamos connected to two large water wheels. There is also sufficient steampower in reserve in case of low water or trouble with ice.

WASHINGTON, D. C.—Bids will be received until Jan. 30 by Captain John Stephen Sewell, Corps Engineers, U. S. A., Construction Officer, U. S. Soldiers' Home, Washington, D. C., for erecting a building for a power plant and for electric elevators for the new mess hall and dormitory at the Soldiers' Home.

MARIETTA, GA.—The plant of the Georgia Manufacturing & Public the power house for the Macon & Albany electric railway.

AUGUSTA, GA.—Promoters of the Charleston & St. Andrew Railway will soon apply to the City Council for a franchise to run its line through Grove Street.

PELHAM, GA.—H. S. Jawdon, of Savannah, and Ludwig & Co., of Atlanta, are the engineers for the proposed water works, sewerage system, electric light plant and ice plant.

MARIETTA, GA.—The plant of the Georgia Manufacturing & Public Service Company, which supplies the city with water and electric light, was recently damaged by fire, causing a loss of $250,000.

WRIGHTSVILLE, GA.—The City Council has selected Arthur Pew, of Atlanta, to prepare plans and superintend the construction of water works and an electric light plant, for which $35,000 bonds were recently voted. Bids for the bonds will be received on Jan. 2 by J. W. Brinson, Jr., Mayor.

ALBANY, GA.—Application for a charter for the Albany Power Company has been made by Alex W. Smith, Frank L. Meufville and E. M. Underwood. The company will be capitalized at $25,000, with the privilege of increasing to $2,500,000, and will engage in buying, selling, leasing and operating dams, water powers, power houses and in the manufacture of all kinds of machinery operated by water or electric power.

WALLACE, IDAHO.—An ordinance has been passed by the City Council granting a franchise to William J. Hall to build and operate an electric railway in this city.

BOISE, IDAHO.—W. D. Kenyon, Paul R. Kartzke, J. C. Rogers, I. G. Hale and T. B. Lee have been granted a charter by the County Commissioners to build and operate a railway from the south bank of the Snake River, in Boise, into the city of Oakley, a distance of 25 miles.

FISHER, ILL.—William Kidd has purchased the electric lighting plant in this place, owned by Wardner & Wardlow.

ABINGDON, ILL.—The Mutual Union Telephone Company has increased its capital stock from $10,000 to $15,000.

JOLIET, ILL.—E. H. Corle, of Joliet, writes that David Lay, of Red Lodge, Mont., is engineer for the proposed electric light plant.

FREEPORT, ILL.—Charles E. Gregory, of Chicago, Ill., is endeavoring to secure a franchise for a new gas and electric lighting plant in this city.

BLOOMINGTON, ILL.—The directors of the Illinois Traction Company are contemplating the building of an interurban underground system in this city, at an expenditure of $50,000. L. E. Fischer is manager.

SPRINGFIELD, ILL.—A contract has been awarded by the Southeastern Traction Company to the Turner Construction Company, of New Orleans, La., for the construction of an interurban electric railroad from this city to Pana, a distance of 50 miles. The contract price is $33,000 per mile. Dr. Dixon, of New Orleans, is promoter of the enterprise.

CICERO, IND.—The electric lighting plant owned by John Plaine was destroyed by fire Dec. 22.

DANVILLE, IND.—J. H. Wilson has sold the electric light plant, franchises and holdings to James F. Lynch.

NOBLESVILLE, IND.—The power house of the Cicero Electric Light Company has been destroyed by fire, causing a loss of about $6,000.

LIGONIER, IND.—A deal has been closed by which the Wilmot Telephone Company passes into the control of J. E. Armstrong, of Leesburg.

FARLEY, IA.—The city is said to be considering the installing of an electric light plant.

VINTON, IA.—A. H. Turner, county auditor, writes that the contract for installing electric light fixtures in court house has been awarded to W. C. Vosburgh, of Chicago, Ill., for $1,687.

FT. DES MOINES, IA.—Bids will be received until Jan. 12 by W. E. Cole, Constructing Quartermaster, U. S. A., for furnishing and installing electric light fixtures, transformers and installing watt meters, and wiring for electric lighting in public buildings at this post.

ROSSVILLE, KAN.—T. W. Andrews has begun the construction of an electric light plant for his estate near here.

WALNUT, KAN.—The Council has agreed to grant a franchise to W. N. Coron, of Carlisle, Ark., to establish an electric light in this place.

ELLINWOOD, KAN.—The city has purchased the plant owned by E. Bockenrohle. For the present the plant will be used for commercial and residential lighting and will not furnish light for the town.

INDEPENDENCE, KAN.—The Union Traction Company is contemplating the construction of a line connecting Cherryville, Parsons and Independence. The work will commence on the construction of the line about April 1.

WEST MONROE, LA.—C. E. Faulk, city secretary and treasurer, writes that the proposed electric light plant will cost $10,000.

ALEXANDRIA, LA.—An election will probably soon be held to vote on issuing $25,000 bonds for extending water works and electric light plant.

BUCKSFORT, ME.—Preliminary surveys are being made at Alamoosook for the proposed power plant, which will furnish Bucksport and Orland with electricity for lighting purposes.

AUBURN, ME.—F. D. Gordon, of Auburn, superintendent Lewiston & Auburn Electric Light Company, writes that nothing will be done in the way of rebuilding the power plant in New Auburn, recently burned, until spring.

LEWISTON, ME.—A new unit is being installed in the plant of the Libby-Dingley Company and will be in operation within two weeks, which will be appreciated by the users of electricity, as the supply has been limited since the plant on the Little Androscoggin River was burned.

WEST STOCKBRIDGE, MASS.—Parrish Brothers have secured the contract to install the electrical plant at West Stockbridge for Mr. Bossidy, and will also put in the street lighting system.

UXBRIDGE, MASS.—The J. W. Day Electric Company of this place has secured the contract for the wiring of the Excelsior Mills, of Farnumsville, for electric light. About 600 incandescent lamps will be installed.

BOSTON, MASS.—Mayor Fitzgerald has vetoed the ordinance passed by the Board of Aldermen, Dec. 13, granting a franchise to the Metropolitan Home Telephone Company to construct a telephone system in the city.

LOWELL, MASS.—Plans are now being prepared for the enlargement of the Perry Street station of the Lowell Electric Light Corporation, and it is understood that construction work will commence early in March.

BOSTON, MASS.—The Edison Electric Illuminating Company has petitioned the Gas and Electric Light Commissioners for permission to increase its capital stock by the issue of 24,200 shares at a par value of $100 per share.

TEMPLETON, MASS.—In contradiction of the report that the town of Templeton was to be asked for an additional $10,000 for electric light, C. Aylmer Smith, chairman of the electric light board, states that about one-third of the appropriation of $21,000 has been paid out to date, and that the board expects the work to be completed well within the appropriation. The work is progressing as rapidly as possible and in a few weeks the streets will be lighted by electricity from the municipal lighting plant.

PITTSFIELD, MASS.—It is expected that the Consolidated Street Railway Company will abandon the Zylonite power house in Adams within the next year or two and that the electricity to operate the Berkshire road and the Hoosac Valley & Bennington Street Railway will be generated at the Pittsfield power house. Plans for the change have been considered by the engineers of the Consolidated Company for some time. It is stated that the company has ordered a 2,000-hp engine and generator for the Pittsfield plant and electricity will be transmitted to the North Adams station at 65,000 volts.

SAGINAW, MICH.—The Valley Telephone Company is preparing to enlarge its plant in this city.

IRON RIVER, MICH.—A. J. Lytle and others are reported to have been granted a franchise for an electric light plant.

LAKE ODESSA, MICH.—The Council is reported to be considering the establishment of a municipal electric light plant. Present contract expires in the spring.

DAVIDSON, MICH.—At a special election held December 21, the citizens voted to issue $10,000 in bonds for the construction of a municipal electric lighting plant.

HOLLAND, MICH.—W. H. Orr, manager of the Citizens' Telephone Company, announces that the company has decided to install an automatic telephone system in this place.

HASTINGS, MICH.—The Thornapple Gas & Electric Company has installed a new water wheel at the La Barge dam. The company now has ample power to meet all present contingencies.

ALBION, MICH.—Application has been made to the City Council by G. H. White and George Mindeman, of Chicago, Ill., and Joseph Taylor for a franchise for an electric railway to run north to Charlotte and Lansing.

STAMBAUGH, MICH.—A ten-year franchise, authorizing the construction and operation of an electric light and power plant, has been granted by the Village Council to A. J. Lytle, of Norway, and associates, and as soon as possible in the spring the work of installing the new system will be commenced. An ultimate expenditure of $200,000 is contemplated. The power plant will be located at the Hemlock Rapids, on the Paint River, eight miles from the town. It is said that 6,000 hp can be developed, which will be sufficient to accommodate not only the villages of Iron River and Stambaugh, but all the mines in the vicinity. The maximum rate to be charged for incandescent lighting will be 10 cents per kw-hour and for street lighting $60 per arc lamp per year on an all-night schedule.

STAPLES, MINN.—A new electric lighting plant is being installed in this place.

BRAINERD, MINN.—At a meeting of the business men held recently the proposition of the Brainerd Hydro-Electric Power Company to furnish the city a minimum of 450,000 kilowatts of electric power for one year for $12,000 was indorsed and the Council was asked to give them a contract. The City Council will take up the question at its next meeting.

ST. PAUL, MINN.—The City Council is reported to have on December 20 awarded the contract for lighting the city by electricity for 1907 to the St. Paul Gas Light Company, at $96 each for arc lamps in conduit district, and $86 each for overhead arc lamps. At present there are 78 arc lamps supplied by underground wires and 640 overhead arc lamps. The Assembly on Dec. 20 passed the electric franchise ordinance of the Northern Heating & Electric Company as it was received from the Aldermen. It is said that the company will begin work on its electric lighting system as soon as possible. It is provided in the ordinance that 11 miles of conduits and overhead wires shall be completed and in service within 3½ years after the date of acceptance of ordinance. The company now has conduits in a number of the downtown streets of the city.

HATTIESBURG, MISS.—The Hattiesburg Traction Company is contemplating the erection of a power plant adjoining the gas plant in the near future.

BETHANY, MO.—The City Clerk writes that early in the Spring bids will be received for improvements to the electric light plant to cost about $6,000. J. F. Slinger is superintendent and electrician.

ELBA, NEB.—The citizens here are considering the matter of installing an electric light plant.

CLAY CENTER, NEB.—It is reported that application has been made for an electric light franchise.

LINCOLN, NEB.—The Electrical Equipment Company has secured the contract for furnishing the lighting fixtures for the new Elks' temple.

BEATRICE, NEB.—R. R. Kyd, manager of the Beatrice Gas & Power Company, writes that M. E. Springer, of Beatrice, has secured the contract for improvements to the plant, to cost between $75,000 and $100,000.

HINSDALE, N. H.—A new electric light and power plant is being installed in the Haile & Frost mill by the Western Electric Company.

MORRISTOWN, N. J.—The business men are said to be making preliminary arrangements for the formation of a company with a capital of $200,000 to build a combined electric and gas plant.

TRENTON, N. J.—The Public Service Corporation has had plans drawn for the erection of a three-story office building on Warren Street, also for a power house which will have double the capacity of the company's plant on Chauncey near Warren Street. The new buildings and the equipments will cost in the neighborhood of $500,000. The addition to the power house will be 50x100 feet. The addition will be a complete plant in itself and will have room for three 1,500-hp turbo-generator sets.

NEWARK, N. J.—A communication from the People's Light & Power Company has been received by the West Caldwell Borough Council, agreeing to comply with that municipality's request for street lamps, providing poles are furnished free to the company. It is desired to light Fairfield Avenue, from Bloomfield Avenue to Francisco place, Old Road and 1,500 feet of Bloomfield Avenue westerly from Fairfield Avenue. It is felt that the company is not justified in its demand for poles, as the price of lighting would be the same there as elsewhere. The matter has been laid over until it can be discussed with a representative of the company.

AZTEC, N. M.—H. F. Matheson has applied to the Town Council for permission to erect and operate an electric light plant and furnish electricity for lighting and other purposes.

HAMBURG, N. Y.—The Town Board has granted a franchise to the Niagara, Lockport & Ontario Company, Ltd., for 25 years.

SCHENECTADY, N. Y.—The Schenectady, Marketsville, Hancock & East Branch Railway Company has been given permission to build the Schoharie Valley line.

SANDY HILL, N. Y.—The Union Bag & Paper Company is contemplating the construction of a hydro-electric plant and dam at a cost of $250,000. The plant will have a capacity of 12,000 hp.

GENEVA, N. Y.—The Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company has been granted permission to increase its capital stock from $450,000 to $1,000,000 and to make a new bond issue of $1,000,000.

BROOKLYN, N. Y.—C. B. J. Snyder, superintendent school buildings, New York City, has awarded the contract for electric equipment of the Eastern District High School, Borough of Brooklyn, to Frederick Pearce Co., for $39,785.

PLEASANT PLAINS, S. I., N. Y.—Bids will be received until Jan. 7 by C. B. J. Snyder, superintendent of school buildings, New York City, for installing electric equipment in additions to and alterations in School 3, Pleasant Plains, Borough of Richmond.

SALEM, N. Y.—The Salem Light, Heat & Power Company, of Salem, has been incorporated, with a capital of $50,000. The directors are: John F. O'Brien, of Plattsburg; Jarvis P. O'Brien, of Troy; W. A. Reynolds and M. A. W. Whitcomb, of Whallonsburg.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Company has decided to construct a new track in Milton Avenue from the city line ot the end of the Solvay branch in the village of Solvay. The Council of Solvay is now considering the company's application for a franchise.

CANANDAIGUA, N. Y.—At the meeting of the Board of Supervisors on December 18 resolutions were passed instructing the Light Committee to communicate with various firms and to obtain bids for erecting complete lighting plants, including dynamos and gas engines, to be installed in the State Armory at Geneva and at the Court House and in the jail at Canandaigua.

MONROE, N. Y.—A meeting of the stockholders of the Orange & Rockland Electric Company has been called to vote on a proposition to increase the capital stock from $50,000 to $100,000. The company now furnishes electricity for lighting Monroe, Central Valley, Highland Mills, Chester and Washingtonville. Roscoe W. Smith is president, and Zael W. Paddleford, secretary.

NEW ROCHELLE, N. Y.—Permission has been granted by the New Rochelle Common Council and the Village Trustees of Larchmont to the New York, New Haven & Hartford Railroad Company to widen its roadbed to accommodate eight tracks and to operate an electric line between these points, completing the company's electric railway system from the Harlem River to Boston.

COHOES, N. Y.—Work on the new distributing station which is being erected by the Hudson River Electric Power Company in this city, has been discontinued for the winter. As soon as the weather permits in the spring the company will finish the building and begin the work of laying the conduits for its service throughout the city. The company is contemplating making an application to the Common Council for a lighting franchise early in January.

BUFFALO, N. Y.—The State Board of Railroad Commissioners has granted the Frontier Electric Railway Company authority to increase its capital stock from $300,000 to $1,500,000, and has consented to allow the company to issue a mortgage for $2,000,000 to secure bonds. The company is owned by the International Railway Company and will build two more tracks for electric cars between Buffalo and Niagara Falls. The line will be built on private right of way, for which the commissioners granted a certificate of necessity some time ago.

SCHENECTADY, N. Y.—It is reported that the General Electric Company will after the first of the year dispose of its interests in the Schenectady Illuminating Company to a corporation to be organized in this city. At the present time, it is said, the Schenectady Illuminating Company is handicapped in equipment. The time has come when extensions and improvements, the estimated cost of which will run well up into the millions, must be made. As soon as the new company is incorporated and the transfer made bonds will be issued for a large amount. It is said that the new company has secured valuable water power privileges near Schuylerville and elsewhere and that large power houses will be erected which will make the local company entirely independent of the Hudson River Power Transmission Company, which is at present furnishing a large percentage of the electrical energy from its Spier Falls plant. While the General Electric Company will not control the new company, it is the general understanding that prominent officials of the company will take stock in the new corporation.

CHARLOTTE, N. C.—The Southern Power Company has awarded the contract for building a railroad from Kings Creek to the new power site at Ninety-Six Island, on the Broad River, a distance of five miles.

HENRIETTA, N. C.—It is reported that S. B. Tanner, president of the Henrietta Mills, of Henrietta, has purchased the Green River Falls water power property and will develop the power for the purpose of furnishing electricity to operate a cotton mill which he and others intend building. Between 600 and 700 hp is to be developed.

RALEIGH, N. C.—A franchise has been granted by the Board of Aldermen to the Capital City Telephone Company, which will take over the local exchanges of the Southern Bell and the Interstate companies, the Bell having the controlling interest in the new company. The new company will install an entirely new plant in a building of its own to cost $20,000.

HAMILTON, OHIO.—The city has sold $65,000 electric light improvement bonds.

TOLEDO, OHIO.—The City Council has passed the ordinance which provides for electric lamps to be placed on Elm and Peck Streets.

DELAWARE, OHIO.—The stockholders of the Citizens Telephone Company have voted to increase the capital from $125,000 to $200,000.

BARBERTON, OHIO.—The Massillon & Northern Electric Company has petitioned the City Council for a franchise to operate its lines in the streets of the city.

ASHTABULA, OHIO.—A site at the corner of bridge and Joseph Streets has been purchased by the Ashtabula Telephone Company on which an exchange building will be erected at an early date.

CLEVELAND, OHIO.—Bids will be received until Jan. 10 by the Board of Public Service, for arc lamps, transformers and accessories needed for the extension of the Cleveland municipal lighting plant. A. R. Callow is secretary.

FINDLAY, OHIO.—A company is being organized for the purpose of building an electric railway from Findlay to Tiffin and Norwalk. The road will be known as the Cleveland & Indianapolis Interurban Railway, P. W. Ewing, of Findlay, is secretary.

CLEVELAND, OHIO.—The Cleveland Telephone Company has purchased the property adjoining its present building at the corner of Champlain and West Third Streets, to provide for increased space which the rapid growth of its business demands.

CLEVELAND, OHIO.—Solicitor Stage has decided that Cuyahoga County can not go into the lighting business. The county building commission had planned to erect a plant for the group plan in Cleveland to supply both the county and city buildings with light and power, selling electricity to the city. Mr. Stage says that the county may operate its own lighting plant, but has no authority to sell electrical energy.

NORMAN, OKLA.—The City Council has granted a fifty-year franchise over certain streets of the city to the Tecumseh, Guthrie & Norman Electric Railway.

EUGENE, ORE.—John F. Kelly and J. S. Magladry, owners of the Mohawk Lumber Company, have filed notice of the appropriation of 500 miners' inches of the waters of McGowan Creek, a tributary of the Mohawk River for the purpose of generating electrical power, etc.

PORTLAND, ORE.—The Oregon Electric Company, successor to the Willamette Valley Traction Company, is contemplating the construction of an electric line up the valley to Albany, and to shorten the distance between Albany to Portland to 75 miles. C. F. Swigert is president.

BAKER CITY, ORE.—The City Council has contracted with the Baker Light & Power Company to furnish electricity for lighting the city for one year. The city is contemplating the erection of a municipal electric light plant next year, and to utilize the water power from its gravity water system.

PITTSBURG, PA.—Architect C. Emile Miller, Homeopathic Hospital, writes that the proposed power plant for this building will cost about $25,000.

PHILADELPHIA, PA.—Thomas C. Trafford is asking for sub-bids on the cost of alterations and additions to power house No. 34, at 1313 North Twenty-seventh Street for the city.

PHILADELPHIA, PA.—The Philadelphia Electric Company has secured the contract for furnishing the electric lighting in the city for the year 1907, at $1,124,224.

NEWBURG, PA.—Sealed proposals for lighting the streets for a period of three or five years will be received until Jan. 7, by Henry Afflerbach, chairman of committee on lighting.

EAST WASHINGTON, PA.—The Borough Council has granted a franchise to the Washington & Canansburg Street Railway Company to build and operate a street railway line on East Beau Street, for a term of 99 years.

SCRANTON, PA.—Mayor Dimmick, on Dec. 18, signed the ordinance requesting Director of Public Works Acker to prepare plans and specifications for an electric lighting plant, to furnish lights for city streets and buildings.

PROVIDENCE, R. I.—The Narrangansett Electric Lighting Company is installing a 2,700-hp Curtis steam turbine in the Narragansett power house. When the turbine is in operation the capacity of the Narragansett station will be 9,000 hp.

WESTERLY, R. I.—It is stated that the parties who own the East Lyme franchise and who built the Groton & Stonington and the Norwich & Westerly electric railways will petition the Legislature for a charter to build an electric railway from the present westerly terminus of the New London & East Lyme Railroad to the Connecticut River. If this line is constructed it will complete a direct shore line route from Westerly to New London and New Haven.

HARTSVILLE, S. C.—Bids will be received until Feb. 1 by the Commissioners of Public Works (J. J. Lawton, chairman), for $41,000 bonds to be issued for the purpose of constructing and operating a system of water works and plant for sewerage and lighting purposes.

PARSONS, TENN.—The Parsons Marble and Granite Works of this place are making preparations to furnish electricity for lighting the town.

CHATTANOOGA, TENN.—It is stated that the Chattanooga Railways Company will soon ask for a franchise for a line on the west side to the top of Cameron Hill and Boynton Park.

CLARKSVILLE, TENN.—W. B. Young, City Recorder, writes that the City Council has passed the ordinance requiring the Cumberland Telephone & Telegraph Company and the Home Telephone Company to place all its wires underground by Sept. 1, 1907.

FREDERICKSBURG, TEX.—The electric lighting plant owned by Christian Stehling has been purchased by G. A. Pfeil.

MARSHALL, TEX.—Hunter & McCormick, of Shreveport, La., have been granted a franchise for an electric street railway in this place.

RICHFIELD, UTAH.—The Richfield Electric Light & Power Company is installing a hydro-electric plant and hopes to have it in operation by the middle of February. Owing to the scarcity of coal the steam plant of the company is unable to meet the demands made upon it. Thomas Brown is president and general manager.

BELLOWS FALLS, VT.—The auxiliary plant of the Fall Mountain Electric Light & Power Company at Forest was put into operation Dec. 15 for the first time and is now taking the place of the steam plant on the island.

GROTTOES, VA.—The city is securing preliminary estimates on the installation of an electric lighting plant.

TACOMA, WASH.—The Huckley Wightman franchise for another street railway line to Seattle has been granted by the City Council.

SEATTLE, WASH.—The Seattle, Renton & Southern Railway Company is contemplating the construction of a branch line to Kennydale, Eden and Newcastle.

SPOKANE, WASH.—It is reported that the Spokane & Big Bend Railway Company will soon advertise for the construction of 79 miles of road, and that construction work will commence as soon as possible.

SPOKANE, WASH.—A mortgage of $500,000 has been filed by the Interstate Telephone Company in favor of the Spokane & Eastern Trust Company to secure funds for the extension of the telephone line to Wallace, Idaho.

CASTLE ROCK, WASH.—Preparations are being made to rebuild the electric light plant which was destroyed by the flood last month at a loss of $10,000. It is said that the plant will be rebuilt on a more extensive scale. H. D. Gates, of Hillsboro, Ore., is owner.

SPOKANE, WASH.—We are informed that contracts are yet to be let by the Washington Water Power Company, of Spokane, in connection with its proposed power plant for everything except turbo-generators and boilers; probable cost of proposed plant, $800,000. W. S. Barstow & Company, 56 Pine Street, New York, N. Y., are the engineers.

MARINETTE, WIS.—The New York-Wisconsin Company, which was recently organized for the purpose of constructing cement works at Rush Lake, is contemplating the construction of an electric railway from Rush Lake to this city.

KAUKAUNA, WIS.—The Green Bay & Mississippi Canal Company is reported to be making a survey of the lower water power in this city for the purpose of developing the power. There is said to be about 2,000 hp available. Capt. N. M. Edwards is engineer in charge.

CODY, WYO.—The City Council has granted a franchise to the Northwest Wyoming Construction Company to construct and operate an electric railway from the Burlington Depot, which is located some distance from the town and through the principal streets of the city. The company is composed of J. R. Painter, Russell Kimball, George T. Beck and George B. Taylor, all of Cody.

Legal.

AN OLD TELEGRAPH SUIT.—Judge John R. Hazel of the United States circuit court has signed a decree in the suit of Harrington, Edison and Reiff vs. the Atlantic & Pacific Telegraph Company and the estate of Jay Gould. This case has been pending for thirty years and prosecuted alone by Reiff against Gould and the telegraph company. The principal associates excepting Edison have died meantime. The decision was very broadly in favor of Reiff and Edison and handed down January 25, 1906. The decree orders an accounting in favor of the plaintiffs. The patents have expired. The case involves the invention of Edison in automatic telegraphy as well as the quadruplex.

RIGHTS OF ELECTRIC LINEMAN INJURED WHILE STRIPPING POLE.—An inexperienced lineman, unacquainted with the methods used for the protection of those engaged in the work of stripping and lowering poles, was directed by his foreman to strip a decayed pole without being given any instructions as to how to set about the work. He climbed the pole without inspecting or testing it in any manner and was injured while at work. It appeared that the company for which the lineman worked had notice of his inexperience; at least there was evidence tending to show such notice. It was held that the lineman was not guilty of negligence in climbing the pole without making an inspection or in releasing the span wire while the guy wire was still attached. The company was held to be under a duty to instruct its inexperienced employe and to be liable in damages for his injuries. The duty of instruction may arise on the part of a master in the case of an inexperienced adult employe the same as in the case of a child. Sias vs. Consolidated Lighting Company, Supreme Court of Vermont.

CONTRACT FOR PURCHASE OF STOCK IN CORPORATION.—The promoters of a private corporation, learning that one Feitel was desirous of subscribing to some of the stock of the corporation, mailed him the following form, asking him to fill it out and return: "Kindly place my name for .... shares at the price of one hundred and fifty dollars per share, being one hundred dollars par value and fifty dollars surplus—subject to allotment by the organization committee. I bind myself to pay for this stock on the call of the organizers." Feitel signed the slip and filled it out for one hundred shares. Upon the incorporation of the company Feitel was left out and he brought an action against the promoters for breach of contract. It was held that the sending in of the application by Feitel was a mere offer to purchase one hundred shares of stock. As the offer was not accepted by the defendants there was no contract, and, consequently, the plaintiff had no cause of action. Where an individual applies for shares in a company, there being no obligation to let him have any, there must be a response by the company, or there is no contract. Feitel vs. Dreyfous, Supreme Court of Louisiana.

SALES OF STOCK IN FOREIGN TELEPHONE COMPANY DO NOT CONSTITUTE "DOING BUSINESS" WITHIN MISSOURI STATUTE.—The sale of shares of stock in the State of Missouri, the stock being that of a telephone company incorporated in Delaware, does not constitute "doing business" within Missouri, Rev. St. 1899, Sections 1024, 1026, providing that a foreign shall comply with certain requirements before it shall be permitted to transact business within the State and denying to any foreign corporation doing business without such compliance the right to sue in the State courts upon any demand, whether in contract or in tort. There is no doubt that the contract of any foreign corporation, doing business in Missouri without complying with the statute mentioned, is void. But the transaction of business referred to in the statute means the business which the foreign company was incorporated to engage in. The business of a telephone company does not consist in disposing of some of its stock to an individual and such act is not doing business within the statute. Therefore, although a telephone company has not fulfilled the requirements necessary to transacting business in Missouri, the negotiable promissory note which it receives for shares of stock sold in that State is a valid obligation and may be recovered on by the company or its endorsee. First National Bank vs. Leeper, Kansas City (Mo.) Court of Appeals.

DAMAGES AGAINST TELEGRAPH COMPANY FOR MENTAL ANGUISH RESULTING FROM FAILURE TO DELIVER TELEGRAM.—Where a telegram, addressed to the plaintiff, notifying her of the death of her stepson and the hour set for burial, was delayed in being delivered, through the negligence of the telegraph company, the plaintiff was entitled to recover damages from the telegraph company for the mental anguish suffered, as a result of not being notified of the funeral in time to attend it. Damages for mental anguish are as old as the law. They have been allowed by all courts in cases where there has also been a showing of physical suffering. In many instances damages for mental suffering, unaccompanied by physical suffering, have been allowed, for instance in actions for libel, slander, malicious arrest, wrongfully ejecting a passenger from a train, etc. Upon the question of the liability of telegraph companies for damages for mental anguish resulting from their negligence in handling messages the courts of the United States are divided. North Carolina is one of the States holding the view that such damages are recoverable. Harrison vs. Western Union Telegraph Company, Supreme Court of North Carolina.

ASSUMPTION OF RISK BY EMPLOYE.—In an action brought by a servant to recover damages for injuries from his employer, it appeared that the plaintift was engaged in operating a machine used for the purpose of thinning out rubber. The machine became clogged with the rubber which was passing through it and the plaintiff went to work to cut the rubber away with a knife, as he had been instructed to do, when his hand was caught in the revolving rolls of the machine and injured. The theory of the master's negligence was based upon his failure to provide a certain kind of a clutch which it was alleged would have stopped the rolls in time to have prevented the accident. The plaintiff had been employed about the machine and had seen similar machinery for seven years and he testified that he understood the position of the rolls of the machine and the manner of their operation. He understood that the machine could not be stopped while there was rubber between the rolls except by shutting off the power. It was held that he had assumed the risk incident to the absence of the style of clutch which would have stopped the machine in time to have saved his hand and that he could not recover for his injuries. Roche vs. India Rubber & Gutta Percha Insulating Company, Supreme Court of New York, Appellate Division.

ACTION AGAINST TELEGRAPH COMPANY FOR FAILURE TO DELIVER MESSAGE—PROOF THAT MESSAGE WAS DELIVERED TO COMPANY NECESSARY.—In a suit for damages against a telegraph company for failure to deliver a telegraphic message, it is necessary for the plaintiff to establish that the message was delivered to the company for transmission. This is not accomplished by proof that the plaintiff's agent, in an attempt to deliver the message for transmission, used the telephone, calling upon the telephone company for a connection with the office of the telegraph company, and, upon being answered by one supposed to be in the telegraph office, asked, "Is that the Western Union Telegraph office?" and, upon being assured in the affirmative, repeated to the person so answering the message intended to be sent; it not appearing that the agent of the plaintiff recognized the voice of the person who answered him as being the voice of one of the agents of the telegraph company, and it not being otherwise known to him or shown that the person to whom he was talking was the agent of the telegraph company. It may possibly have been, argued the court, that the telegraph operator failed to connect the plaintiff's agent with the office of the telegraph company. If such connection was in fact made, the higher and better evidence would have been the testimony of the operator of the telephone company. Planters' Cotton Oil Company vs. Western Union Telegraph Company, Supreme Court of Georgia.

Obituary.

MR. N. P. YEATMAN.—Mr. Nathaniel Pope Yeatman, secretary and treasurer of the Nashville Railway & Light Company, since its reorganization in 1895, and prior to that time holding the same responsible position in the old Nashville Street Railway Company and in the Cumberland Electric Light Company for fifteen years, died suddenly in bed at his residence, Nashville, Tenn., on Dec. 18. A post-mortem examination disclosed the fact that Mr. Yeatman had been dead about an hour when discovered by Mrs. Yeatman, who went to his bedroom to awaken him for breakfast. He was a son of James E. Yeatman, long one of the pioneer business men of middle Tennessee, and later a widely known philanthropist of St. Louis. The son inherited his father's charitable characteristics and never let his left hand know what his right hand was doing, but kept both busy trying to aid his fellow men. Mr. Yeatman was in his fifty-fourth yeear. He has resided in Nashville about half of that time.

Personal.

MR. OTTO E. BROWNELL, who has been operating the Lake City, Ia., plant under lease for 2½ years, took possession on December 26, and will now operate it as owner. The consideration is $18,000.

MR. ASA M. MATTICE has discontinued his business as consulting engineer to become manager of the works of the Walworth Manufacturing Company, South Boston, Mass., the duties of which position he assumed January 1.

PROF. A. F. GANZ.—A reprint has been made in pamphlet form, from the *Franklin Institute Journal*, of the treatment by Prof. Ganz of the physical meaning of power factor and the significance of a power factor less than unity without phase differenee.

MR. C. J. FRANKLIN, who has been connected with the Tacoma Railway & Power Company, of Tacoma, Wash., has been appointed general superintendent of the Portland Railway, Light & Power Company, Portland, Ore. Mr. Franklin will fill a post newly created and will not displace any of the present offieers.

MR. VICTOR L. SCOTT, of the San Antonio, Tex., Gas & Electric Company, has issued a revised edition of his digest of the law, decisions, and insurance regulations directed against gasoline lighting and use. It is a suggestive and pertinent document. Sample copies will be furnished by Mr. Scott free to any gas or electric company, upon request.

MR. EDWARD R. GRIER, who has been associated with the Bryant Electric Company for the past 15 years as assistant manager, has resigned for the purpose of opening general sales offices in New York City for various lines of electrical specialties. Among other things he has secured is the "Arrow P" snap and push button switches.

SIR CLIFTON ROBINSON is the subject of a recent full-page portrait in the London *Tattler*, as the British "king of electric traction," while to the same issue he contributes a very interesting article on tramways. It is full of reminiscences dating back to the time when Frain installed the first English tramway at Birkenhead. Sir Clifton is now the managing director and engineer of the London United Tramways, Limited.

MR. G. A. ILER.—Mr. George A. Iler, formerly with the Western Maryland Railway Company as electrical engineer and superintendent of its motive power and machinery at all its large mines, has resigned to accept the position as electrical engineer and superintendent for the Las Vegas Railway & Power Company, Las Vegas, N. M. He was formerly chief electrician in the U. S. Navy and instructor in branches of government uses of electricity.

News of the Trade.

THE OHIO ELECTRIC SPECIALTY COMPANY, of Cleveland, Ohio, has changed its title to the Tregoning Electric Manufacturing Company.

HALLER MACHINE COMPANY.—Hereafter all correspondence addressed to the Haller Machine Company should be directed to 319 South Clinton Street, Chicago, instead of 129 Fulton Street.

ELECTRIC SERVICE SUPPLIES COMPANY.—The advertising department of the Electric Service Supplies Company, Mr. C. H. Bristol, manager, has been moved to Philadelphia, and the address now is 1020 Filbert Street.

THE KILBOURNE & CLARKE COMPANY, of Seattle, Wash., has been appointed Northern Pacific agent for the Ajax Line Material Company, of Chicago. This will add to its large supply of stock an assortment of the Ajax mast arms, arc lamp pulleys, arc insulators, toggle-bolts and incandescent street hoods.

DOSSERT & CO., 242 West Forty-first Street, New York City, manufacturers of the well-known Dossert joints and solderless connectors and terminals for wires and cables, will exhibit a full line of their appliances, including many new and novel features at the coming Electrical Trades Exposition, Chicago, in section F, space No. 6.

A BRILLIANT CONFERENCE.—A number of the salesmen of the Brilliant Electric Company were in Cleveland during holiday week in conference with Mr. E. J. Kulas, general manager of the company. On Thursday evening, Mr. Kulas entertained them at a banquet at the Colonial Hotel. The following gentlemen were present: G. R. Newcomer, E. V. Hennecke, G. O. D'Urfor, R. S. Jackson, D. W. Hopper, C. R. Tock.

PASS & SEYMOUR, INC., have had to make a few changes in personnel recently at the Chicago end of their business from the fact that the volume there is so great it is more than one man can handle to advantage; besides which they desire to have their representatives get around to see their customers oftener. Mr. Geo. V. W. Ingham has been transferred from the main office to Chicago, as western sales agent, in charge of the territory controlled from Chicago. Mr. Ingham has been at the factory for some time, and therefore is well posted in the line, and is in a position to handle all conditions very satisfactorily. Mr. A. S. Merrill remains in Chicago also as assistant western sales agent, so that the concern now has a strong and effective force in that territory.

THE WESTERN ELECTRIC COMPANY will show at its booth, at the coming Electrical Show at the Coliseum, Chicago, a very large and handsome water color painting of its new 110-acre plant at Hawthorne, Ill. It will distribute at the booth souvenir postal cards, showing a reduced reproduction in colors of this picture and will be very glad to give these gratis to visitors to mail to their friends as souvenirs. Its

exhibit will include, American transformers, Thomas high-tension insulators, Electros insulating material, Western Electric Company's arc lamps, and direct and alternating-current motors, its series and multiple lamps for both alternating current and direct current. It makes a specialty of a direct current indestructible lamp, the magnets of which are wound with Deltabeston magnet wire and will give a demonstration of the heat resisting qualities of this wire as compared with cotton-covered magnet wire. Another interesting feature will be that of a series alternating equipment in full operation, including switchboard, regulator and transformers. It will also show its new 1907 line of fan motors and a switchboard equipped with some recently perfected devices. An indestructible field coil for railway motors, wound with Deltabeston wire and guaranteed for one year, is an article which will form no small part of its display. Its new 20-inch arc lamp is something entirely out of the ordinary in the arc lamp field. It will have a sample connected up at its booth, showing that fuses may be entirely omitted without injury to the lamp. Its new induction motor, recently perfected, merits inspection. It will be shown in actual operation. A demonstration of its sewing machine motors will prove attractive to the ladies. The company has made ample preparations to take care of customers and guests and will provide for their convenience a stenographer, telephone, stationery and a general bureau of information.

THE NATIONAL BATTERY DEPOT, of Chicago, located at 271 Michigan Avenue, has been opened by Mr. George S. Berger, who has been associated with the storage battery business in Chicago for many years, and a complete stock of electric vehicle and sparking battery parts will be carried, so that prompt repairs and renewals can be made of any standard sized battery as well as any National battery. The National Battery Company's sales offices, at 450 Old Colony Building, will be, as heretofore, under the management of Mr. Bertram Smith, and any communications with either of these addresses will receive prompt attention.

A FIFTIETH ANNIVERSARY does not come very often in the history of American manufacturers, but the house of I. P. Frink can boast that the New Year brings with it its fiftieth anniversary. A half century of reflector making—food for reflection, indeed! Right up through the long line of improvements in illumination and illuminants, Frink reflectors have varied as oil, gas, acetylene and electricity have introduced new problems and conditions, and their success shows that the correct principles grasped at the outset have been adhered to and followed through the long evolution. The headquarters at 551 Pearl Street, New York, afford many interesting examples of this in relics of bygone stages in the art. No reputation is better established than that of I. P. Frink in such varied fields as the lighting of art galleries, churches, libraries, public buildings, stores, halls, etc., and the firm was specialist in "illuminating engineering" long before that branch of work was even suspected to exist by the great majority of mankind. During the past year the old reputation has been further entrenched by good work, and the output of reflectors, etc., has been limited only by the capacity of the factory. The firm has no misgivings as to trade prospects in the near or the dim future, but goes forward to another jubilee strong in the friendship and confidence of patrons who have dealt with it throughout the long past, and in the immediate period of electrical growth.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, S. S. Sadtler, 59 S. 10th St., Philadelphia.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, fourth Friday of each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, 12 West 31st St., New York. Spring meeting, Indianapolis, Ind., May, 1907.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting, Detroit, Mich., third Wednesday, September, 1907.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, 60 Wall St., New York.

Association of Edison Illuminating Companies. Secretary, Geo. R. Stetson, New Bedford, Mass.

Association of Electric Lighting Engineers of New England. Secretary, Welles E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Atlantic City, N. J., June 19, 1907.

California Independent Telephone Association. Secretary, P. T. Whittier, Spencer, Cal.

Canadian Electrical Association. Secretary, T. S. Young, Toronto, Ont.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col. Next meeting, September, 1907.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary-Treasurer, Geo. H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can. Next annual meeting, Montreal, January 14, 1907.

Electrical Trades Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

Empire State Gas and Electrical Association. Secretary, R. A. Davidson, 58 William St., New York. Next meeting, November, 1907.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, Dr. Arthur H. Elliot, 4 Irving Place, New York. Meetings in New York, second Friday of each month.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Railway Association. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

Iowa Electrical Association. Secretary, L. B. Spinney, Iowa State College, Ames, Ia. Next meeting, Clinton, Ia., April, 1907.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Sioux City, Ia., March 12-14, 1907.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Clinton, Ia., May, 1907.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., October 16, 1907.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association. Secretary, A. C. Marshall, Port Huron, Mich.

Missouri Independent Telephone Association. Secretary, Houck McHenry, Jefferson City, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. C. L. Eglin, Philadelphia, Pa.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee Street, Utica, N. Y. Next meeting, New York City, July 17, 18 and 19, 1907.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next annual meeting, Chicago, second Thursday in June, 1907.

National-Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y. Next meeting, Syracuse, N. Y., June, 1907.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, O.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, O. Next meeting, Columbus, O., last Thursday in April, 1907.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, O.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, O.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, N. Y., 1907.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado, Springs, Col. Meetings second Saturday of each month.

PUBLIC UTILITIES ASSOCIATION OF INDIANA. Secretary, J. A. Shunk, Peru, Ind. Regular meetings second Thursday in May and December. Next meeting Indianapolis, January, 1907.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Sioux Falls, S. D., Jan. 9 and 10, 1907.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, E. B. Meginnis, Dallas, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass. Next meeting, March, 1907.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vermont.

WESTERN SOCIETY OF ENGINEERS, Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 25, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

839,095. AUTOMATIC TELEPHONE EXCHANGE FOR DOUBLE-WIRE TELEPHONE SYSTEMS; Gotthilf A. Betulander, Stockholm, Sweden. App. filed Mar. 9, 1903. Relates to specific details.

839,096. APPARATUS FOR COOLING ELECTRIC MOTORS AND GENERATORS; Benson Bidwell, Chicago, Ill. App. filed May 28, 1906. The motor or dynamo has an air-tight casing enclosing the same and forming an expansion chamber for a cooling agent. Compressed air passed through cooling coils is employed for this purpose.

839,113. ELECTRICAL CONVERTER; William B. Churcher, Cincinnati, O. App. filed June 29, 1903. In a converter, a plurality of electrodes adapted to receive a current in one direction, an electrode adapted to transmit the current so passed, and a plurality of coils respectively traversed by alternating currents of different phase.

839,117. WEATHERPROOF SUBSTATION PROTECTOR; Frank B. Cook, Chicago, Ill. App. filed July 30, 1906. Construction of the casing for fuses, etc., of a telegraph or telephone substation. A vitreous block has a central post and a sheet metal cover secured thereon by a bolt through said post.

839,186. AIR BRAKE SYSTEM; Jay Noble, St. Louis, Mo. App. filed July 10, 1905. In order to insure the application of the brakes immediately throughout a long train, the patentee has an electric connection established by the air pipe which operates magnet valves to release the air at all the cars simultaneously.

839,210. COMPOSITE SYSTEM OF TELEGRAPHY AND TELEPHONY; Harry O. Rugh, Sandwich, Ill. App. filed Oct. 20, 1906. Has a special arrangement of retardation coils by which the telegraph and telephone messages are transmitted over the line without interference.

839,216. CIRCUIT CLOSING MECHANISM; Thomas W. Small, Cleveland, O. App. filed May 17, 1905. A specially constructed hanger has a pair of spring impelled depending shoes or fingers which engage contact blocks supported by the trolley harp.

839,224. COUPLING DEVICE FOR ELECTRIC CONDUCTORS; Harold Stokes, London, England. App. filed Feb. 5, 1906. A pair of insulating blocks are respectively provided with a pair of plugs and a pair of sockets therefor and a threaded sleeve is effective to connect the blocks in a manner similar to an ordinary threaded sleeve pipe connection.

839,250. CONTROLLER; Thorsten Von Zweigbergk, Preston, England. App. filed May 21, 1906. A form of controller having a vertically projecting lever similar to an elevator controller. The lever has special thumb operated detents or fingers by which different effects of control may be attained.

839,255. CIRCUIT OPENING DEVICE FOR ELECTRIC HEATERS; James I. Ayer, Cambridge, Mass. App. filed May 5, 1905. In order to avoid overheating the resistance element of an electrically heated cooking utensil, the patentee provides a specially constructed fuse in the circuit.

839,256. CONDUCTOR SUPPORT FOR MOVABLE TOOLS; James I. Ayer, Cambridge and George T. Gilbert, Northampton, Mass. App. filed Dec. 22, 1905. An electrical connection for self-heating flat irons, having a horizontal spring arm suspended above the work table and adapted to keep a uniform tension in the electrical conductor regardless of the position of the flatiron.

839,257. ELECTRICAL RESISTANCE METAL; Adelbert O. Benecke, Newark, N. J. App. filed Jan. 5, 1906. A form of resistance element adapted for resistance boxes where it is desired to obtain a high resistance in a compact space. A metallic ribbon is insulated and the resistance wire is wound spirally over the insulation. The whole may afterward be bent into any desired compact compass.

839,259. RHEOSTAT; Adelbert O. Benecke, Newark, N. J. App. filed Apr. 9, 1906. A resistance box employing a resistance element constructed in accordance with the above patent. Has a plurality of commutators for making the different resistance connections.

839,260. FLEXIBLE CONNECTION; Andrew Benson, Chicago, Ill. App. filed Sept. 1, 1905. One wire has its end made with a spiral spring, and the other wire has a conical pin adapted to enter said spring and be held therein by the resiliency of the convolutions.

839,268. SUPPORT FOR SURGICAL NEEDLES; William R. Burch, Chicago, Ill. App. filed July 14, 1905. A form of supporting arm for the flexible connections of a plurality of electric needles used for dehairing processes.

839,291. ELECTRIC SIGNALING APPARATUS AND CIRCUIT; Felix B. Herzog, New York, N. Y. App. filed Jan. 24, 1900. A cheap form of annunciator making use of electrolytes which are colored by the action of the current instead of magnets. The electrolyte is contained in a large bottle and the particular location discolored indicates the particular call received.

839,306. ELECTRIC CIGAR LIGHTER; David Misell, New York, N. Y. App. filed Jan. 22, 1906. A dry battery is contained in a casing and its terminals connected to a filament in a small metallic cage. When the cage is touched by an alcohol sponge, the circuit is closed so as to heat the filament to incandescence.

839,340. THERMOSTAT FOR JOURNAL BEARINGS; ETC.; Frank A. Vath, Chicago, Ill. App. filed Sept. 19, 1904. A small metallic thermometer is screwed into the journal box and the mercury establishes connection with a needle in case the temperature exceeds a certain amount.

839,343. HEATING DEVICE; Frederick M. Vogel, Lynn, Mass. App. filed Apr. 22, 1905. The flatiron is cored out with a cylindrical chamber so as to receive a resistance element which is removable or replaceable whenever desired.

839,346. LINE-TEST CONNECTOR; Aubrey Wardman, Whittier, Cal. App. filed Dec. 18, 1905. A plate of springy sheet metal is impressed in a die to strike up curved tongues thereon which are capable of receiving and making electrical connection with a circuit wire.

839,358. ALTERNATING-CURRENT GENERATOR; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed May 5, 1905. In an alternating-current generator, a field-winding provided with a rectifying-commutator and brushes, an armature-winding arranged in sections, means for connecting said sections in varying relations to the work-circuit, and an auxiliary exciting-winding carried by the armature and connected to said brushes.

839,365. PROTECTIVE DEVICE FOR SIGNAL SYSTEMS; Fred B. Corey, Schenectady, N. Y. App. filed Aug. 1, 1904. In order to avoid the relays from being injured by excessive current due to potential fluctuations in the track rails, patentee has a cut-out magnet which operates by the passage of current of predetermined strength.

839,371. METHOD OF COATING ACTIVE MATERIAL WITH FLAKE-LIKE CONDUCTING MATERIAL; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed Mar. 30, 1905. The process of covering active particles with flake-like conducting material, which includes adding a sticky material to and mixing the same with the active particles, whereby a sticky film will be applied to each particle, and in then mixing a flake-like material with the coated active particles, whereby the scales or flakes of the former will cover the individual particles of the active material, substantially as set forth.

839,374. INSULATED ELECTRIC CONDUCTOR; William L. R. Emmet and Wallace S. Clark, Schenectady, N. Y. App. filed Nov. 9, 1901. The bundle of wires which constitute the cable are surrounded by a special varnish embodied in the insulation and which never becomes dry or hard. Is designed to be always sticky so as to permit the cable to be bent without destroying the insulation.

839,375. POWER TRANSMISSION APPARATUS; William L. R. Emmet, Schenectady, N. Y. App. filed Apr. 4, 1906. An electrical arrangement for reducing the speed of a steam turbine to adapt it to screw propellers. The turbine drives a specially constructed three-phase generator which in turn acts on a three-phase motor, but the motor is synchronous at half or a quarter the speed of the generator, depending on the arrangement of the circuits established by a controller. In this way the speed is not only reduced but is controllable as well.

839,376. ELECTRICAL STATION INDICATING SYSTEM; Josef Esser, Munchen-Gladbach, Germany. App. filed Dec. 27, 1904. An index wheel is propelled by a pawl and ratchet operated by an intermittent current in the manner of the ordinary printing telegraph. Relates to details of construction.

839,384. PARALLEL FEEDER PROTECTION; Laurence A. Hawkins, Schenectady, N. Y. App. filed May 21, 1904. Relates to protective devices for electrical transmission systems employing parallel feeders; provides means for cutting out one of a number of parallel feeders whenever a fault occurs upon that feeder, whether the faulty current is large or small.

839,401. ALTERNATING-CURRENT MOTOR; Maurice Milch, Schenectady, N. Y. App. filed June 17, 1904. In an alternating-current motor, an armature-winding provided with a commutator and brushes, and short-circuiting connections between equi-potential

points on the field-winding, said connections being utilized and connected as the terminals of the field-winding.

839,404. SAFETY APPLIANCE; Harry W. Morris, Oak Park, Ill. App. filed May 19, 1904. A device for raising the door of a freight elevator. The door is counterweighted and connected to a special hoisting motor, the circuits of which are controllable by emergency devices, so that the door can be quickly closed in case of fire.

839,430. INTERLOCKING PLUG SWITCH; Arthur R. Smith, Schenectady, N. Y. App. filed Sept. 21, 1904. In switchboards for three-phase circuits, plugs are used for connecting the different feeders to different bus-bars. In order to prevent short circuiting it is neecessary that two plugs be not simultaneously inserted to connect the same circuit to both terminals of the same generator. Patentee has the jacks arranged so that it is impossible to insert two plugs simultaneously into such jacks.

839,455. ELECTRIC SIGN APPARATUS; Frank B. Cook, Chicago, Ill. App. filed Jan. 30, 1904. A plurality of devices are arranged to control the circuits of different groups of lamps by the expansion of air under the influence of heat in said devices. Chambers with diaphragms and heat coils are used for this purpose.

839,462. CEILING SWITCH; Frank L. Fenn, Schenectady, N. Y. App. filed July 13, 1903. The casing has a laterally projecting arm from which depends a cord. When the cord is pulled, the arm acts on a ratchet wheel to open and close the circuit successivly.

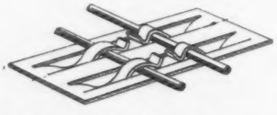
839,482. ELECTRIC ARC LAMP; Charles E. Jones, New York, N. Y. App. filed Feb. 16, 1905. Details of construction of an arc lamp feed, adapted particularly to locomotive headlights. The operating coil is specially arranged with respect to the parabolic reflector of the lamp.

839,492. TYPE WRITING MACHINE; Andrew T. MacCoy, Dover, Mass. App. filed Dec. 30, 1904. Relates to a complete printing telegraph machine such as is used for printing stock quotations on ordinary sheets or pages as distinguished from a tape.

839,502. ELECTRIC MOTOR; Eugene W. Myers, Bloomfield, N. J. App. filed Mar. 21, 1905. The motor casing is in two parts with lugs so arranged that they are locked together by the shaft of the armature. The form is such that they may be cast on a chill so as to avoid the necessity of machining or finishing the interior surfaces.

839,505. ENGINEER'S ALARM; Edward McClintock, Merriam Park, Minn. App. filed Sept. 20, 1905. Special trolleys are arranged adjacent the usual track rails and circuits for various signal purposes are established in the locomotive cab.

839,257.—Electrical Resistance Material.



839,346.—Line Test Connector.

839,513. ELECTRIC CIRCUIT PROTECTOR; Charles A. Rolfe, Chicago, Ill. App. filed Dec. 3, 1900. A heat coil or carriage is supported by a pair of spring arms or fingers so as to permit the arms to separate and open the circuit in case the current exceeds a certain amount. Graphite is used as a resistance element.

839,519. ELECTRICAL SWITCH AND SOCKET KEY; Herbert L. Smith, Bridgeport, Conn. App. filed Feb. 15, 1906. A spindle or bar is cleft at the end and deflected into two branches which are embedded in the hard rubber button of the key.

839,522. HOLDER FOR COMMUTATOR BRUSHES; Oscar M. Stiegler, Boston, Mass. App. filed July 14, 1905. The commutator brush is held in a special form of sheet metal support to which it is permanently attached. This support is received in a clamp so that the brush can be instantly removed and replaced.

839,525. RAILWAY SIGNALING SYSTEM; Louis H. Thullen, Edgewood Park, Pa. App. filed Jan. 4, 1904. Relates to a signaling system having track rails energized by transformers which are interconnected in a special way so as to secure overlap signal features.

839,526. TROLLEY POLE HEAD; William J. Wagner, East Bradford, Pa. App. filed Oct. 28, 1905. The harp has upwardly projecting spring arms on each side which support curved shoes which travel on the wire but separate in passing hangers, etc.

839,530. PANEL-BOARD; Joseph J. Wesley, New York, N. Y. App. filed Jan. 29, 1906. In order to economize space and at the same time preserve the necessary insulating features of a panel or distributing board, the patentee has a supplemental base of vitreous material supported away from the main base or surface and the potential and the neutral bus-bars are on opposite sides of this supplemental base. The switch levers move in such a way as to still further economize space on the board.

839,549. RAILWAY SIGNAL; Aricola La Carpenter, Mt. Vernon, N. Y. App. filed Sept. 19, 1905. A piston is normally prevented from movement to close a circuit by the pressure of air in a chamber and a valve adjacent to the track rails is depressed by the car wheels to release the air from the chamber and close an alarm circuit.

839,563. SPLICE FOR ELECTRIC WIRES; Conrad J. Dorff, Chicago, Ill. App. filed Nov. 18, 1905. A piece of sheet metal is bent so as to form two adjacent parallel tubes which receive the wires to be connected.

839,564. ELECTRICAL CONDUIT TERMINAL; Conrad J. Dorff, Chicago, Ill. App. filed Dec. 21, 1905. A piece of sheet metal is bent to form a ring or torus which may be placed at the terminus of a conduit pipe to prevent the conductors from being abraded by the sharp edges.

839,585. MANUFACTURE OF LUMINANT FOR ELECTRIC LAMPS; John A. Heany, York, Pa. App. filed Nov. 27, 1906. A filament for incandescent lamps consisting exclusively of a metallic alloy of tungsten and titanium on a dense shiny coherent state and homogeneous throughout.

839,606. STORAGE BATTERY; Jang Landsing, Boonton, N. J. App. filed Nov. 24, 1905. A Plante battery-plate having a frame provided with ribs, active members in the form of unit strips supported at a plurality of points by cross-supports secured to the ribs, said plates having intervals opposite the ends of the strips to afford provision for expansion, the outer cross-supports being connected by flexible strips to the corners of the frame, the plate also having spaces opposite the ends of the cross-supports to permit expansion.

839,612. VARIABLE-SPEED POLYPHASE MOTOR; Ralph D. Mershon, New York, N. Y. App. filed Sept. 23, 1903. In a system of power transmission, the combination of an alternating-current motor, leads thereto for a number of phases sufficient to give an approximately uniform rotating field with a uniform winding, and means for varying the number of poles without varying the number of phases, as set forth.

839,636. ELECTRIC CUT-OUT SWITCH; Peter Peters, Pawtucket, R. I. App. filed Feb. 20, 1906. A pair of spring fingers are impelled to open the circuit simultaneously at two points, and a detent may be released to allow said levers to move simultaneously. The detent and the levers are re-positioned by a single cam.

839,637. POCKET AMMETER; Hermann Poehn, Jersey City, and Maximilian Juruick, New York, N. Y. App. filed Dec. 1, 1905. A form of ammeter having a ring-shaped electromagnet with no permanent or residual magnetism and which acts on a pivoted armature so as to displace the same in proportion to the current.

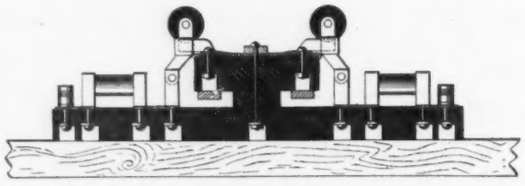
839,655. INCANDESCENT LAMP SOCKET; Frank E. Seeley, Bridgeport, Conn. App. filed July 5, 1906. A substitute for the usual bayonet fastening of the two sheet metal parts of a lamp socket. A pair of prongs are embossed to co-operate with holes in the other member, and these act in conjunction with a spring tongue.

839,665. INSULATOR FOR HIGH VOLTAGES; Louis Steinberger, New York, N. Y. App. filed June 22, 1905. A sleeve or bushing of insulating material is exteriorally threaded so as to be screwed through a partition and has flanges thereon which are also screwed on to the threaded portion to insure a greater arcing distance.

839,666. BUILT-UP INSULATOR; Louis Steinberger, New York, N. Y. App. filed Oct. 28, 1905. A plurality of separate conical insulators are separated by inverted cups which contain oil or insulating fluid.

839,687. MOTOR CONTROL SYSTEM; Harold E. White, Schenectady, N. Y. App. filed Apr. 8, 1905. Controls an induction motor by a resistance connected in the rotor circuit and electro-responsive means operative upon closing the motor circuit for cutting out said resistance.

839,690. ELECTRICAL INDICATING DEVICE; Georg Zapf, Cologne-Nippes, Germany. App. filed Mar. 28, 1905. In order to be able to test out an underground conduit, the patentee has a plurality of special test lines grounded at various points.



839,530.—Panel Board.

839,703. HIGH-TENSION OIL SWITCH; Henry P. Ball, New York, N. Y. App. filed July 2, 1902. Relates to details of an oil switch having plugs which enter forms of spring jacks beneath the surface of the oil.

839,708. ELECTRIC REGULATOR; Joseph Bijur, New York, N. Y. App. filed Feb. 9, 1905. A magnet controlled lever has a pair of depending metallic straps which may be pressed on to the curved surface of a stationary commutator so as to contact with a greater or less arc thereof and cut out successive segments.

839,709. ELECTRIC REGULATOR; Joseph Bijur, New York, N. Y. App. filed Feb. 9, 1905. Relates to another form of the above.

839,710. BOOSTER REGULATOR; Joseph Bijur, New York, N. Y. App. filed Nov. 25, 1905. A still further modified construction of resistance having an electrolyte in annular passages with prongs which may be moved to vary the effective length of the resistance element.

839,711. STORAGE-BATTERY PLATE; Joseph Bijur, New York, N. Y. App. filed Aug. 15, 1906. A battery-plate comprising frames having sides and ends and intersecting ribs, active members in the form of unit elements supported at their central portions upon the intersections of said ribs, and means for securing the frames to each other.

839,712. STORAGE BATTERY; Joseph Bijur, New York, N. Y. App. filed Oct. 17, 1906. The combination with a connecting-strap having projections in the plane of the plate to be attached thereto, and battery-plates burned on to the said projections.

839,713. ELECTRIC REGULATOR; Joseph Bijur, New York, N. Y. App. filed Sept. 24, 1904. A still further modified construction of regulator adapted to move brushes over spaced contacts by the action of an electromagnet.

839,719. DIPPING MECHANISM FOR ELECTROPLATING APPARATUS; David F. Broderick, New Britain, Conn. App. filed July 27, 1906. In a dipping mechanism, the combination with an endless carrier and a series of work-holders movable thereby, of means for automatically and independently raising and lowering each work-holder.

839,742. ELECTRIC CONTROLLER; Edwin C. Fellows, Philadelphia, Pa. App. filed June 1, 1906. A form of motor starter having various features, among them to prevent the controller handle breaking the slate or marble of the controller face when brought in violent contact with the stops thereof.

839,765. ELECTRIC CLOCK; Henry Iversen, Corsicana, Tex. App. filed Sept. 16, 1905. A secondary clock having an electromagnet with a special form of armature adapted to move a pair of depending levers or pawls so as to release and stop the mechanism of the clock so as to keep it in step with the master clock.

839,779. AUTOMATIC ENGINE STOP; Harry M. Martyn, Utica, N. Y. App. filed Mar. 5, 1906. Patentee has a trip connection with a weighted arm which swings to open an air valve so as to admit air into a special cylinder for closing the throttle.

839,788. ELECTRIC SWITCH; Henry L. Smith, Schenectady, N. Y. App. filed May 15, 1905. A form of magnetic circuit breaker adapted for high-tension currents having plugs and jacks beneath the surface of an oil bath and adapted to be operated by a magnet trip outside the casing.

839,794. ELECTRIC THERMOSTAT; Magnus M. Vogel and William J. Meyer, Allegheny, Pa. App. filed July 3, 1906. A U-shaped metal strip is supported by an insulating base so that its central or bent portion is adjacent to a contact point. The extension of the strip under the influence of the heat establishes an electrical connection.